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TRANSACTIONS AND PROCEEDINGS

AND

REPORT

OF MICHIGAN
AUG 3 1972

OF THE

PHILOSOPHICAL SOCIETY

OF

ADELAIDE, SOUTH AUSTRALIA,

FOR 1877—78.

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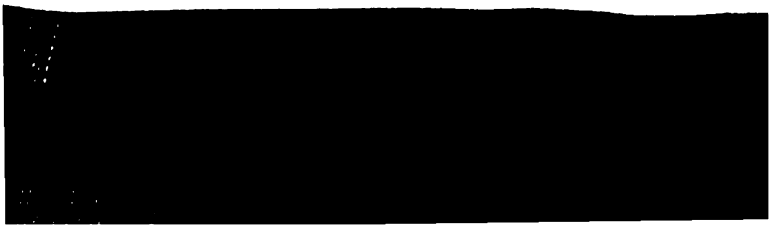
1878.



TRANSACTIONS AND PROCEEDINGS

AND

REPORT

OF THE

PHILOSOPHICAL SOCIETY

OF

ADELAIDE, SOUTH AUSTRALIA,

FOR 1877—78.

ADELAIDE:
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Philosophical Society of Adelaide.

PATRON:

HIS EXCELLENCY SIR W. F. D. JERVOIS, G.C.M.G., C.B., &c.

PRESIDENT:

PROFESSOR RALPH TATE, F.G.S.

VICE-PRESIDENTS:

CHARLES TODD, Esq., C.M.G., F.R.A.S., &c.

R. INGLEBY, Esq., Q.C.

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WALTER RUTT, Esq., C.E.

HON. TREASURER:

THOMAS D. SMEATON, Esq.

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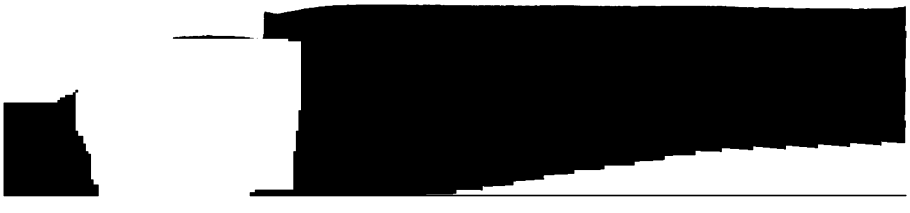
(REPRESENTATIVE GOVERNOR.)

ASSISTANT SECRETARY:

MR. A. MOLINEUX.



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TRANSACTIONS AND PROCEEDINGS

AND

REPORT

OF THE

Philosophical Society of Adelaide,

FOR 1877-78.

ABSTRACT OF PROCEEDINGS.

ORDINARY MEETING, 27TH NOVEMBER, 1877.

Professor TATE, F.G.S., V.P., in the chair.

THE HON. SECRETARY laid on the table "The Statute Index of Tasmania for 1876."

Mr. A. Adamson, jun., was elected an ordinary member.

The CHAIRMAN read a letter referring to the supposed bones of a whale visible in the Murray Cliffs, near Blanchetown.

Mr. D. C. F. MOODIE (visitor) read a paper on "The Non-introduction of Diseased Cattle," which was followed by a discussion.

ORDINARY MEETING, 18TH DECEMBER, 1877.

J. S. LLOYD, Esq., Hon Treasurer, in the chair.

The Rev. W. R. FLETCHER, M.A. (member), read a paper on "The Exploration of Palestine," which was followed by a discussion.

ORDINARY MEETING, 5TH FEBRUARY, 1878.

Professor TATE, F.G.S., V.P., in the chair.

The following gentlemen were elected ordinary members:—Messrs. W. Townsend, M.P., S. Knevett, J. J. Stuckey, M.A., and A. Ringwood.

Professor TATE, F.G.S., V.P., exhibited a piece of rock from Hallett's Cove, which showed a polished and scratched surface, indicative of glacial action.

Dr. SCHOMBURGK (member) read a paper on "Plant-fragments found in the Tombs and other Monumental Buildings of the Ancient Egyptians," which was followed by a discussion.

Mr. T. D. SMEATON, P.V.P., took the chair while Professor TATE read a paper communicated by Mr. Otto Tepper on "The Decrease of many Species of Insects and the Increase of some in South Australia," which was followed by a discussion.

ORDINARY MEETING, 26TH FEBRUARY, 1878.

Professor TATE, F.G.S., V.P., in the chair.

The CHAIRMAN announced that the Council had received the resignation of Mr. W. C. M. Finniss as Hon. Secretary, and that Mr. Walter Rutt would act as Hon. Secretary *pro tem.*

The CHAIRMAN exhibited a selection of fossils, obtained from the Murray Cliffs at Glenforslan, near Blanchetown, in which the original shell is replaced by selenite. He considered these shells to be Eocene, and that our South Australian Tertiary-beds were of older date than had been suspected. A discussion upon the subject ensued.

ORDINARY MEETING, 19TH MARCH, 1878.

Professor TATE, F.G.S., V.P., in the chair.

Mr. Thos. Harry was elected an ordinary member.

Notice of motion was given by Messrs. Tate, Ingleby, Smeaton, Wilson, and Todd, proposing alterations in the Rules, and it was resolved that the same should be printed and circulated.

[SIGNED] Messrs. D. B. Adamson, A. W. Dobbie, J. Macgeorge, and B. H. Babbage, Professor Lamb, and Dr. Schomburgk, with the Council, were appointed a Committee to arrange for a Conversazione; Mr. W. Rutt to act as Hon. Secretary.

Mr. T. D. SMEATON took the chair while Professor TATE read a paper communicated by Mr. Gavin Scoular, on "The Origin of Mineral Veins, with special reference to the Barossa District."

The HON. SECRETARY *pro tem.* read a paper communicated by Mr. H. H. Hayter, F.S.S., Government Statist of Victoria, on "Infantile Mortality in South Australia." A discussion followed, which was adjourned to the next ordinary meeting.

CONVERSAZIONE, 15TH APRIL, 1878.

The Conversazione was held in the Town Hall, Adelaide, which was filled with philosophical instruments, collections of natural history, and other objects of scientific interest, as well as illustrated works upon natural history, and a few specimens of the fine arts. Numerous experiments were performed with the apparatus, and two or three telephones were in operation throughout the evening.

ORDINARY MEETING, 21ST MAY, 1878.

Professor TATE, F.G.S., V.P., in the chair.

The HON. SECRETARY *pro tem.* laid on the table a copy of a paper "On the motion of a screw in an infinite mass of liquid," by Professor

Lamb, and of "A catalogue of the plants in the Botanic Garden, Adelaide," and of "The Annual Report of the Botanic Garden for the year 1877," by Dr. Schomburgk. Copies of the last two works were distributed among the members present.

The following gentlemen were elected ordinary members:—Messrs. Geo. Brunskill and W. L. Ware.

The cordial thanks of the Society were presented to those gentlemen not being members of the Society who had assisted by sending exhibits to the late Conversazione.

The existing Rules were repealed, and a new code, as proposed by the Council, was passed with a few verbal amendments.

The adjourned discussion upon Mr. Hayter's paper on "Infantile Mortality in South Australia" was continued.

ORDINARY MEETING, 18TH JUNE, 1878.

Professor TATE, F.G.S., V.P., in the chair.

The following officers were elected for the remainder of the session:—As Honorary Secretary, Mr. Walter Rutt, C.E.; as Vice-President, Mr. T. D. Smeaton; as Member of Council, Mr. D. B. Adamson.

The HON. SECRETARY laid on the table "The Statistical Register for Victoria for 1876," and "Statistics of Friendly Societies for Victoria for 1876."

Mr. C. A. WILSON (hon. member) drew attention to the recent discovery of two more planetoids.

The HON. SECRETARY read a paper, communicated by Mr. Otto Tepper, on "The Habits and Description of a new South Australian Beetle (*Melolontha destructor*)," which was followed by a discussion.

The HON. SECRETARY read a paper, communicated by Mr. W. T. Bednall, on "Australian Trigonias and their Distribution," which was followed by a discussion.

Professor TATE, F.G.S., V.P., read abstracts of two papers on "Recent South Australian Marginellidæ" and on "Fossil Australian Marginellidæ."

Specimens in illustration of the foregoing papers were exhibited.

Mr. T. D. SMEATON, V.P., exhibited the imago and chrysalides of a large brown and white butterfly, which had within the last few years established itself in South Australia. A discussion followed, in which it was asserted that the species was *Danais Archipus*, that its original habitat was the United States of America, and that it had been observed in Queensland, New South Wales, Victoria, and elsewhere in the Southern Hemisphere.

ORDINARY MEETING, 16TH JULY, 1878.

Professor TATE, F.G.S., V.P., in the chair.

The following gentlemen were elected:—As Corresponding Members—Messrs. H. H. Hayter, F.S.S., Gavin Scoular, and Otto Tepper as Ordinary Members—Mr. A. Adamson, Colonel Biggs, and Dr. Verco, M.D., M.R.C.S.; as Associate—Mr. Stirling Smeaton.

The HON. SECRETARY laid on the table a "List of Land Shells collected on Fitzroy Island," by Mr. John Brazier, C.M.Z.S.

The CHAIRMAN exhibited specimens illustrative of a paper recently presented by himself to the Linnæan Society of New South Wales on "Three new species of Helices;" also corals, including one new species, illustrative of a paper presented to the same Society by the Rev. J. E. T. Woods, F.L.S., F.G.S., honorary member of this Society, on "The extra-tropical corals of Australia."

The HON. SECRETARY read a paper by Mr. Otto Tepper, corresponding member, on "Whirlwinds," which was followed by a discussion.

ORDINARY MEETING, 20TH AUGUST, 1878.

Professor TATE, F.G.S., V.P., in the chair.

The CHAIRMAN referred to his having found near the Murray Mouth a sandpiper, whose foot was clasped by a large Donax shell, which it had probably carried from the Middleton beach. This incident illustrated by analogy Darwin's suggestion that the wide distribution of fresh-water animals and plants was due to the agency of aquatic birds.

Mr. SAMUEL HIGGS, F.G.S. (visitor), read a short abstract of "A list of minerals found in South Australia," which he was compiling for presentation to the Society; and the paper was followed by a discussion.

Mr. CHARLES TODD, C.M.G., F.R.A.S., M.S.T.E., member of Council, read a paper on "The Telephone and the Microphone," followed by experiments.

ORDINARY MEETING, 17TH SEPTEMBER, 1878.

Professor TATE, F.G.S., V.P., in the chair.

The HON. SECRETARY laid upon the table "The Statistical Register of Victoria for 1877; parts 1 and 2;" several volumes of "The Bulletin of the Signal Service of the United States for 1874;" "Smithsonian Report for 1876;" and "Transactions of the Royal Society of Victoria, vols. 13 and 14."

Mr. E. P. Nesbit, jun., was elected Auditor.

Mr. R. Ingleby, Q.C., drew attention to the sympathy existing between the weather in the Southern and that in the Northern Hemisphere. In the latter there had occurred successively a stormy, a dry, a hot, and a wet season. The two former we had already experienced here, and he anticipated a hot summer, and probably a wet November and December.

The CHAIRMAN stated that the old rocks of our hills had hitherto been supposed to be destitute of fossils. He exhibited specimens of a palæozoic limestone obtained by Mr. O. Tepper, corresponding member, near Maitland, which showed possible traces of organic remains. Mr. Tepper had written that he had since found more decisive evidences of fossils.

Mr. Smeaton, V.P., having taken the chair, Professor TATE read a paper by the Rev. J. E. T. Woods, honorary member, on "The Fossil Corals of Aldinga."

Professor TATE then read some supplementary notes on "The Correlation of the Tertiary Strata of South Australia, with a list of species of Tertiary Corals."

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M.S.T.E.
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REPORT OF THE COUNCIL

OF THE

ADELAIDE PHILOSOPHICAL SOCIETY

FOR THE YEAR ENDING SEPTEMBER 30TH, 1878.

In presenting to the members of this Society the twenty-fifth Annual Report of its proceedings, the Council have pleasure in stating that the papers which have been laid before the members during the past year have been of a character worthy of the Society, embodying the results of a considerable amount of original research; and it is a cause of regret that the attendance of members and their friends at our meetings has not, as a rule, been so large as might reasonably have been expected from the quality of the matter submitted. The following is a list of the papers laid before the Society during the year:—

"The Non-introduction of Diseased Cattle," by Mr. D. C. F. Moodie.

"The Exploration of Palestine," by Rev. W. R. Fletcher, M.A.

"Plant-fragments found in the tombs and other monumental buildings of the Ancient Egyptians," by Dr. Schomburgk, Dr. Ph., &c.

"The Decrease of many species of Insects, and the Increase of some, in South Australia," by Mr. Otto Tepper.

"The Origin of Mineral Veins, with special reference to the Barossa District," by Mr. Gavin Scoular.

"Infantile Mortality in South Australia," by Mr. H. H. Hayter, F.S.S.

"The Habits and Description of a new South Australian Beetle (Melolontha destructor)" by Mr. Otto Tepper.

"Australian Trigonias and their distribution," by Mr. W. T. Bednall.

"Recent Australian Marginellidæ," by Professor Tate, F.G.S.

"Fossil Australian Marginellidæ," by Professor Tate, F.G.S.

"Whirlwinds," by Mr. Otto Tepper.

"A list of Minerals found in South Australia," by Mr. Samuel Higgs, F.G.S.

"The Telephone and Microphone," by Mr. Charles Todd, C.M.G., F.R.A.S., M.S.T.E.

"The Fossil Corals of Aldinga," by Rev. J. E. Tenison Woods, F.L.S., F.G.S., &c.

"The correlation of the coral-bearing strata of South Australia, with a list of species of tertiary corals," by Professor R. Tate, F.G.S.

"Subterranean water supply in the Interior," by Mr. T. E. Rawlinson, C.E.

In addition to the ordinary meetings of the Society, a very successful Conversazione was held in the Town Hall, Adelaide, during the month of April, which, as your Council believes, excited considerable interest in scientific subjects, not only among the members of this Society, but also among the general public.

The following works have been presented to the Society's library during the year:—

"The Statute Index of Tasmania for 1876."

"The motion of a screw in an infinite mass of water," by Professor Lamb.

"Catalogue of plants in the Botanic Garden, Adelaide," by Dr. Schomburgk, Dr. Ph.

"Annual Report of the Botanic Garden for 1877," by Dr. Schomburgk, Dr. Ph.

"Statistical Register of Victoria, parts of 1876 and 1877."

List of Land Shells collected on Fitzroy Island; by Mr. John Brazier, C.M.Z.S.

During the year the Council carefully considered the Rules of the Society, and came to the conclusion that it was advisable to revise them, and the amended code, adopted by the Society on the 21st May, is now in force. The chief alterations consist in the numerical increase in the Council, the admission as corresponding members of residents in this Province at a distance from Adelaide, and the creation of the new class of Associates.

Several changes in the Council have taken place, due in part to the adoption of these Rules, and in part to the resignation of the Honorary Secretary, Mr. W. C. M. Finniss. On the 18th June Mr. Walter Rutt, C.E., was elected Honorary Secretary; Mr. T. D. Smeaton, whose office as Past Vice-President was abolished, was elected Vice-President; and Mr. D. B. Adamson a Member of Council.

It is with deep regret that the Council record the death of Mr. John Howard Clark, one of the founders of the Society, and for many years one of its most active members. Mr. Clark filled successively for a considerable time the offices of Secretary and Treasurer; and although of late ill-health prevented him from taking any active part in the proceedings of the Society, his interest in all matters connected with science and literature remained to the last unabated.

The number of members of all classes on the Society's roll at the commencement of the past session was 103, and the present number is 101, as shown in the annexed table. The large number of apparent resignations is due to the fact that the names of several gentlemen, who have for some years discontinued their subscriptions without formally sending in their resignations, are now omitted:—

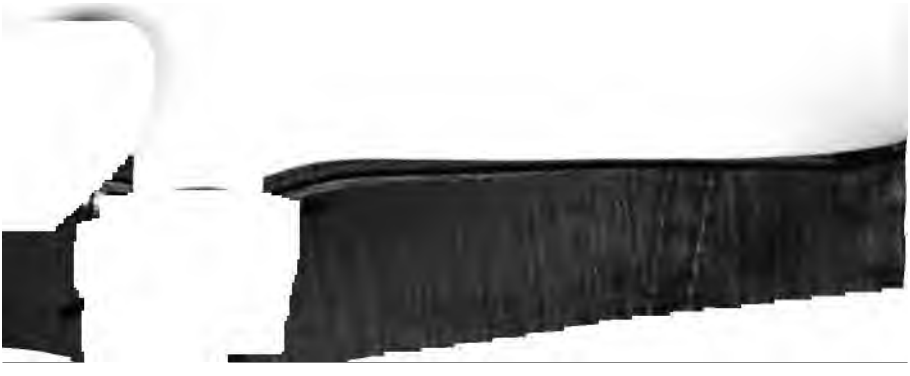
	On Roll Oct. 1, 1877.	During Current Year.			On Roll Sep. 30, 1878.
		Elected.	Died.	Resigned.	
Ordinary Members	88	9	1	12	84
Honorary Members	15	—	2	—	13
Corresponding Members	—	3	—	—	3
Associates	—	1	—	—	1
Total	103	13	3	12	101

It is now some years since the proceedings of this Society have been printed. The Council have, after due consideration, decided to recommence their publication in a form which will be more handy, and more in accordance with that adopted by most of the scientific societies of the world, than that in which they were formerly issued; and they hope that the state of funds will enable the Society to continue the publication from year to year.

Arrangements have been made with the Governors of the South Australian Institute for the exhibition at the Society's monthly meetings of any interesting specimens of Natural History which may have been presented to the Museum of the Institute during the previous month. This will not only impart an additional interest to the meetings, but will be a means of making known the contributions which are continually being made to the Museum, and which cannot at present through want of space be utilized for public exhibition.

In conclusion, the retiring Council would express a hope that their successors will be supported in their efforts to develop the objects of the Society by the united assistance of its members. They desire to impress upon all the desirability of placing upon record in its transactions the accumulated results of the observation and research of the scattered population of this province, which will otherwise be lost to science. They would also draw attention to the opportunity which is afforded by the new class of Associates to ladies and young men to take an interest in the diffusion and advancement of the arts and sciences.

WALTER RUTT, Hon. Sec.



THE TREASURER IN ACCOUNT CURRENT WITH ADELAIDE PHILOSOPHICAL SOCIETY.

Dr.			£ s. d.
October, 1877—			
To Balance			112 16 4
Subscriptions ...	£78 9 6		
Less commission ...	5 17 9		
			72 11 9
			£185 8 1
October, 1878—			
To Balance brought down			£124 15 2

Cr.			£ s. d.
By Rent			12 0 0
Advertising			10 17 8
Printing			11 19 6
Refreshments			8 0 0
Conversazione—			
Expenses ...	£47 19 0		
Receipts ...	31 19 0		
			16 0 0
Postages and Petties			1 15 9
			60 12 11
Balance carried down			124 15 2
			£185 8 1

Audited and found correct, 8th October, 1878.
E. PARISS NESBIT,
Auditor,

Adelaide, 7 October, 1878.
J. F. LLOYD,
Treasurer Adelaide Phil. Soc.

ANNIVERSARY ADDRESS

BY

PROFESSOR RALPH TATE.

GENTLEMEN—The duty of closing this session with an address, which I have been requested to undertake, has not devolved upon me through custom, and it may therefore seem to be presumptious on my part to have accepted it; but I have willingly acceded to the request, because I wish to take the opportunity of touching upon some topics which cannot conveniently be communicated in the ordinary way, and to establish a precedent that will be good to follow at each anniversary of this Society.

I have thought that an account of the general progress that has recently been made towards a better knowledge of the Natural History of South Australia, accompanied by a series of remarks upon the best available authorities to be consulted upon such subjects, might supply a want which I know by personal experience is often felt, and at the same time would form a not inappropriate address from the chair which I have now the honour to occupy. The task of compiling such information would not be very difficult to one who had at his command the well-furnished libraries of the Royal, Linnean, Geological, and Zoological Societies of London; but the few weeks which intervened between my acceptation of the Chair of Natural Science in the University of Adelaide, and my departure for the scene of my future labours, did not afford me time to consult any of those rich stores of scientific literature for this purpose. The information which I am able to submit to you has, therefore, been obtained under adverse circumstances—*e.g.*, isolation from many sources of information, and from the assistance of experts—and in some cases from second-hand sources; and it is not to be expected that the lists of works should be exhaustive, but they will give to the student in search of particular information a clue which may be followed up to the desired source. Our public library is ill supplied with works relating to the Natural History of the Province, and those needful works of reference supplementary thereto, though some endeavours are being made to supply the deficiencies. It, moreover, seems to me that the usefulness of the Reference Library is at present practically nullified through the want of accommodation for readers, and by not allowing access to, and freedom of selection from, the shelves. The library of the University is being rapidly enriched with works indispensable to the student in Natural

Science; these are, for the most part, distinct from those in the National Library. In the following pages the sign * prefixed to the title of a work indicates that the work is in the Library of the South Australian Institute, and a † that it is in the University Library. It will be the privilege of the President elect of this Society to enlarge my summary of works and papers bearing upon the Natural History of this country, and to keep the members *en courant* with what has been done during his year of office to increase our knowledge of the natural products of this continent.

In making ourselves acquainted with the actual extent of our knowledge respecting the Geology, Mineralogy, Zoology, and Botany of South Australia, we are brought face to face with the fact that there are many missing pages, and even chapters, in its history, and we shall learn that our knowledge in many departments is mere technical barrenness. It is one of the functions of the Society to make good these desiderata, and to make the knowledge we have and shall acquire real, practical, and interesting. From what follows, you may gather that there is great scope for work in many branches of Natural Science. No member can plead the want of a subject, and each one, by the careful examination of the natural objects around him, may collect facts which may furnish data for others of higher scientific attainments to collate, arrange, and draw conclusions from — all that is demanded is strict accuracy of detail, and allowing the facts to speak for themselves. Identification of species is a portion, though small, of the business of systematic biology, and short synoptical faunas are useful to the general naturalist. When our Zoology shall have been well investigated, popular hand books and elaborate memoirs will doubtlessly follow. In the preparation of synopses of our fauna, localities should be accurately noted, particularly in the case of insects and land shells, which are of all others those whose local stations are most closely dependent on vegetation. Hitherto the work of description has been done at home, with the disadvantage of mistakes of habit and of multiplication of species, which would be obviated if the species were described in their native country. It seems to be a fruitful source of error as to locality, that of giving the place whence the specimens were despatched as that of the habitat. Several glaring mistakes of this kind might be mentioned. One will suffice. *Moloch horridus* is recorded by Gray, "Lizards of Australia," from *Adelaide* and W. Australia. Several species originally described as from New Holland, have not yet been referred to their true

stations; and the mistake has been made by some
ing South and Southern Australia.

Before entering upon the consideration of the c
of this address, I must premise that my remarks d
Northern Territory, unless specially so stated; and
obvious to all that the Natural History of South Austr
ted, cannot be studied without reference to that of neigh
which together form one large natural province, capable
being subdivided into regions. These regions are not to
existing governmental boundaries, though the preliminary i
may not inconveniently be regulated by them. The definitio
regions must be the result of long and patient study; and w
yet the data for formulating them.

ZOOLOGY.

CLASS MAMMALIA.—"That we know more of the fauna of A
than of other English colonies in different parts of the world is c
but no thanks are due from us for this knowledge, either to the Im
or to any of the Colonial Governments. The unassisted enterprise
private individual has produced the two splendid works upon
Mammals and Birds of Australia, which we all turn to with pleas
whenever reference is required to a member of these two classes of Au
tralian animals. Mr. Gould's 'Mammals of Australia' was completed i
1863. Since that period the little additional information received re-
specting the terrestrial mammals of Australia has been chiefly furnished
by Mr. Krefft, late of the Australian Museum, Sydney, and by his
successor, Mr. E. P. Ramsay, in various papers and memoirs. On the
marine mammals, however, which were scarcely touched upon by Mr.
Gould, we have a treatise by Mr. A. W. Scott, published at Sydney, in
1873, which contains a good deal of useful information concerning the
seals and whales of the Southern Hemisphere."—Dr. P. T. Sclater,
Opening Address, Biological Section, the British Association,
September, 1875.

Mr. F. G. Waterhouse, the curator of the Institute Museum,
furnished a classified catalogue of the mammals and birds which are met
with in South Australia, to Mr. Harcus's (*†) "South Australia, 1876."
The list contains the names of sixty-four terrestrial and three marine
mammals, and is unaccompanied by reference to localities. This omiss
is a great defect, as no judgment can be formed as to their distribution w
our province or to their relation to neighbouring ones; and create

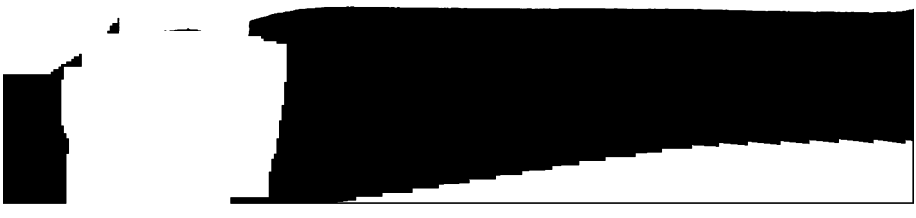
as to the actual occurrence of some species which are usually considered to be restricted within narrow limits in distant parts of the Continent. It is also to be regretted that observations on the habits and distribution of our indigenous mammals are not extant, as year by year they will become more difficult to make, and many of the most rare or local seem to be doomed to extinction through the repellent and exterminating influence of advancing culture of the soil.

CLASS AVES.—The magnificent series of seven volumes of Mr. Gould's (*) "Birds of Australia" was finished in 1848; and in 1869 a supplementary volume was issued containing similar full-sized illustrations of about 80 species. In 1863 Mr. Gould reprinted in a quarto form, with additions and corrections, the letterpress of his great work, and published it under the title of a "Handbook to the Birds of Australia." This is a convenient work for general reference.

My criticisms on Mr. Waterhouse's List of Mammals will apply with equal force to that of his South Australian Birds. The number of species there quoted for this province is 360; but Mr. E. P. Ramsay, in his "List of Australian Birds, 1877," makes mention of only 343. The discrepancy is more than accounted for by the degradation of so-called species to the rank of varieties, whilst Mr Ramsay's list contains a few species not enumerated by Mr. Waterhouse.

CLASS REPTILIA.—(†) "On the Snakes of Australia" we have an excellent work, published in 1869 by Mr. Gerald Krefft, in which a list of the South Australian species will be found. The late Dr. Gray has written many papers on the Tortoises and Lizards of Australia. Of the latter we have to thank Dr. Gunther for a complete monographic list published in 1875 in one of the newly-issued numbers of the (†) "Voyage of the Erebus and Terror." Most of the plates of this work were also issued in 1867 by Dr. Gray in his (†) "Facsiculus of the Lizards of Australia and New Zealand."

CLASS AMPHIBIA.—An indispensable work in this department is Dr. Gunther's (*†) "Catalogue of the Batrachia Salentia," published in 1858, which embraces all the Australian species of the class then known; but additions have since been made and referred to by Keferstein, in his new and little-known Batrachians from Australia, (†) "Neue und wenig bekannte Batrachier aus Australien." As localities are given in both works, it will be an easy task to prepare a list of the South Australian species; and doubtless from the small number therein recorded for this province, an increase to it would reward the collector.



CLASS PISCES.—For information on the fishes of Australia reference must be made to the ichthyological portion of the (*) "Zoology of the Erebus and Terror," by Sir John Richardson, and to the same author's papers on Australian fishes in the "Annals and Magazines of Natural History," 1842-1843, and "Transactions and Proceedings of the Zoological Society of London," 1839-1840. Whilst Gunther's Catalogue (*) of the Fishes of the British Museum, complete in eight volumes, is absolutely indispensable to any one engaged in the study of fishes; and no ichthyologist should be without "Cuvier's and Valencienne's Histoire Naturelle des Poissons."

The Count F. de Castlenau has in the last few years published in the "Proceedings of the Zoological and Acclimatization Society of Victoria, 1872," several papers on the fishes of the Melbourne Fishmarket and of other parts of Southern Australia, which include a complete synopsis of the known Australian species.

It may be of interest to know that the fishes of Port Darwin have recently undergone critical examination at the hands of Mr. W. Macleay (Proc. Linnean Soc. N. S. Wales, 1878). One hundred and twelve species are cataloged, 21 of which are described as new. Frequent reference is made to Dr. Bleeker's "Atlas Ichthylogique des Ind. Or. Nederl."

SUB-KINGDOM MOLLUSCA.—In the department of Marine Conchology we have a good foundation to work upon in the "Lists of all the known species of marine mollusca of the province of South Australia," by G. F. Angas, which are contained in the Proc. Zool. Soc., London, for the year, 1865. The number of species therein recorded is:—Cephalopoda, 2; Branchiogastropoda, 229; Conchifera, 96; Brachiopoda, 1. Seventy-eight of the species were unknown to science till described from Mr. Angas's specimens, during the eighteen months preceding the publication of the 'Lists' by Messrs. H. & A. Adams, H. Crosse, and himself.

Such are the results of Mr. Angas's indefatigable exertions during a residence of some years in this province; and because nearly every species mentioned had been collected by him, the catalogue is that of the bona fide molluscan inhabitants of our waters. Though Mr. Angas still pays considerable attention to Australian conchology; yet he has not published anything further in continuation of the above-mentioned papers, excepting that of correcting the nomenclature of a few species in papers on the molluscan fauna of New South Wales, published in Proc. Zool. Soc., ranging from 1867 to 1877, and adding three new forms

in a paper published in this year. These papers are invaluable to the South Australian conchologist, as a fair proportion of shells are common to the two areas. Mr. Angas, in his papers, *op. cit.*, 1865, not only gives lists of names, but adds remarks on the habitats and distribution of each species, and supplies references to works wherein the species are described or figured.

The bibliography is certainly voluminous, but a large number of the descriptions and figures are collected together in a monographic form in Reeve's "Iconica Conchologica." The University Library contains the monographs of the more important Australian genera, and the following works dealing with Australian shells:—Lamarck, 'Animaux sans Vertebres,' 7 vols.; Menke, 'Molluscorum Novæ Hollandiæ; Quoy & Gaimard, 'Voyage de l'Astrolabe; Zoology of the Voyage of H.M.S. Samarang; Journal de Conchyliogie; Cruise of H.M.S. Curaçoa; Gould's 'Otia.

A glance at the numbers of representatives of each class of the mollusca, recorded by Mr. Angas, reveals the paucity of cephalopods and brachiopods, and the absence of pteropods; whilst a reference to the papers discovers the absence of an entire order—that of Nudibranchs or sea slugs. The poverty of the brachiopods is doubtlessly real, though a second species, *Kraussia Lamarckiana*, is known by me to occur; but it is not so with regard to the cephalopoda. Ten species of naked cephalopods I have collected in St. Vincent's Gulf, but so little attention has been paid to animals of the class in Australia that our book knowledge respecting them is very meagre. A careful examination and description of all the existing species would well repay the researches of any one of our naturalists. Quoy and Gaimard describe some Australian cuttlefish, and D'Orbigny's Monograph, and Gray's Catalogue of the classes are indispensable.

The absence of pteropods and nudibranchs from Mr. Angas's lists may be intentional on the author's part, and it is not unreasonable to infer that examples of each class exist on and off our shores, as they are both well represented in the seas of the east coast of the continent. Of Pteropods, 14 species are known in New South Wales. The chief works relating to the class are:—Eydoux and Souleyet, 'Voyage of the Bonite,' (1836-37), and Rang and Souleyet, 'Histoire Nat. des Mollusques Pteropodes,' 5 pl. (1852.) The nudibranchs of New South Wales are 34 in number, most of which are described as new, and beautifully illustrated by M. Crosse, (*) Journal de Conchyl, 1864.

The classes Polyzoa and Tunicata are not noticed by Mr. Angas, the

study of which is not generally pursued by conchologists. to them separately.

The additions to our lists of species of marine mollusca a in the following works and papers:—A. Adams, in Sowerby's " Conchyliorum," describes three species of *Cyclostrema* from the same loca Reeve identifies two species of *Cyclostrema* from Port Lin previously known Japanese shells. These and the foregoing spe described and figured in Reeve's "Iconica Conch."

Mr. T. Bednall, in a "List of South Australian Marine S privately printed 1874, inserts thirteen gasteropods and three biv not previously known to occur with us.

A census of the marine gasteropods, bivalves, and brachiopods Tasmania and the adjacent islands (Proc. Roy. Soc. Tasmania, 1877), the work of the Rev. J. E. Tenison Woods. It bears evidence of co siderable labour spent in its preparation, as it contains all the specie recorded by previous authors, and all the new species, which are many, described by Mr. Woods in two papers published by the same Society; and the claims of critical and doubtful species are discussed. Those interested in the distribution of the constituents of the marine fauna of Australia will find this production of great service. The horizontal range of some of the species is indicated; but the omissions in this respect are unfortunately many, and the comparative unity of the Tasmanian fauna is rendered more apparent than real. Mr. Woods makes known the occurrence of eleven gasteropods and one bivalve in the south-eastern part of our coastline, which are not mentioned as South Australian by previous observers. He has also corrected the names of some of our species.

The same author, in a paper "On some new Marine Mollusca," Roy. Soc. of Victoria (1877), states on my authority that *Pectunculus laticostatus*, so abundant in a fossilized state in Southern Australia and Tasmania, is living in St. Vincent's Gulf.

Angas, Proc. Zool. Soc., March 1878, adds two species of *Mitra* and one of *Siphonaria* to the local fauna—the three are new to science.

In the pages of this volume will be found a small contribution by myself to South Australian conchology.

Mr. Angas is now publishing in Proc. Zool. Soc. an appendix to his list of 1865. From material received from me he adds fifteen known species of gasteropods and seven of bivalves to our fauna, and describes as new to science seven species of gasteropods and four of bivalves. A

second collection recently forwarded has not been reported on. The total recorded additions are—Gasteropoda 58, Conchifera 16, Brachiopoda 1; but these do not exhaust our knowledge, as I am acquainted with nearly as many more unrecorded species.

Class Polyzoa.—Some evidence of the neglected state of Australian zoophytology up to comparatively recent times may be gathered from the circumstance that out of fifty-four species of twenty-four genera of Polyzoa described by Busk in the Appendix to "Voyage of the Rattlesnake" (1852), forty species are new or undescribed, and four genera are instituted. Forty-two were collected in Bass's and Banks' Straits, one at Port Adelaide, the remainder off other parts of the Australian Continent.

Some of our Australian species are common to the seas of Europe; these are described in (†) Johnston's "British Zoophytes."

In 1860, Macgillivray, in Trans. Phil. Inst., Victoria, vol. iv., pp. 97-98, one plate, and pp. 159-168, two plates (in Library Philosophical Society, Adelaide) wrote upon the Polyzoa of Southern Australia. Four species are credited to South Australia. Professor Hutton's Catalogue of the Marine Mollusca of New Zealand (1873) should be consulted.

In 1875 there appeared (*) Part III of Busk's Catalogue of the Polyzoa 8vo, 34 plates. This contains descriptions of sixteen Australian species of Cyclostomatous Polyzoa, only five of which had been previously recorded—two by Macgillivray and three by Busk, op. cit. (Copies of Parts I. and II. of the Catalogue of Polyzoa are not in the colony, and these portions of the work are out of print.)

Rev. J. E. Tenison Woods, in Trans. Roy. Soc. of New South Wales (1877), describes two new species of South Australian Polyzoa belonging to the genus *Serialaria*.

Hincks, "Notes on the genus Retepora," An. & Mag. Nat. Hist., May, 1878, describes two new species of the genus, and supplies much fuller and more minute diagnoses than we have from the authors who named them—of three others—all of which are stated to have been collected in South Australian waters.

Professor Hutton, in a short paper recently communicated to the Royal Society of Tasmania, describes six new species, and identifies nineteen with known forms. These were collected by myself upon the shores of St. Vincent's Gulf. Some of them are of great interest. *Tubulipora flabellaris* had not been found in the Southern Hemisphere before, and *Vincularia maorica* had previously been known only as a miocene fossil.

The total number of known South Australian polyzoa is thirty-five.

Class Tunicata.—Quoy and Gaimard describe and figure fourteen species of simple and compound ascidians from the south-west and south-east coasts of Australia. Some of these will doubtless be found to form a part of the comparatively rich tunicate-fauna of our shores.

Land and Fresh-Water Mollusca.—A special work on the Land Snails of Australia exists as (†) "A Monograph of Australian Land Shells," by Dr. Cox, published in 1868. The figures of some of the South Australian species are not accurate, and the diagnoses are not always sufficiently full. The number of South Australian Helices published in Dr. Cox's monograph is twenty-two; but since then additions have been made, which make a total of thirty-four. Mr. Angas describes six in Proc. Zool. Soc. for the years 1868, '73, '75, '76, and '77; Mr. Brazier two in the same journal for 1871 and 1872, and a third in Proc. Lin. Soc, N. S.W., vol. 1., 1875; and I have made known three other forms in Proc. Lin. Soc., N.S.W., vol. 2, 1878. No advance has been made in the numbers of species of the other genera constituting our terrestrial molluscan fauna. I think that a revision of our species is needed, but efore considering the claims of several to specific rank it will be desirable to have more information respecting their distribution. Most of our land snails are, according to book knowledge, very restricted, and each is more or less isolated. If this be really so, then we should seek to establish a connection between their isolation and the development of that character proper to each.

No attempt has been made to bring together in a monograph the scattered sources of information concerning the fresh water mollusca of Australia. But the Rev. J. E. Tenison Woods has arranged the fresh water shells of Tasmania, *vide*, "On the Freshwater Shells of Tasmania," (Proc. Roy. Soc. Tasmania), 1876; of which there are 28 univalves and four bivalves, the majority being described as new to science. Woods in 1875 held the opinion that this part of the Tasmanian fauna is perfectly distinct from that of Australia, and that its facies or general character is not Australian; but two years later, when describing some new freshwater shells inhabiting Victoria (Trans. Roy. Soc. Vict, 1878), he takes an opposite view. The freshwater shells of Australia and Tasmania have a common character, and many of them are widely distributed, being common to several hydrographical areas. The identification of the South Australian species will involve considerable labour, as all the Australian freshwater shells and their animals must be re-

viewed before any satisfactory result can be arrived at. We have in the extra-tropical part of this province several species of *Physa*, some *Lymnæa*, an *Ancylus*, *Planorbes*, *Melaniæ*, *Paludinæ*, and several so-called *Bithynias* and *Paludestrinas*, a *Pomatiopsis*, *Unios*, and a *Cyrena*. Some South Australian *Physæ* are described in Reeve's Monograph of the genus. The *Cyrena* of the Lower River Murray is named *C. Angasi* by Prime, Journ. de Conch., vol. xii, 1864; and Mr. Angas in Proc. Zool. Soc., 1877, describes a new *Paludinella* from Lake Eyre.

Class Insecta.—Entomology has long been a favourite pursuit among Englishmen, Frenchmen, and Germans, and with so many workers and with an almost unbounded field of research, it is not surprising to learn that the literature of this class of animals is most voluminous. Of late years specialists have arisen, and the modern bibliography of any order of insects is more compact and accessible. The descriptions of Australian insects are scattered through so many publications that their long array is enough to dishearten the tyro at the very commencement; but there are a few works which deal largely with Australian entomology, these are:—Donovan's "South Sea Insects," 1805; "Boisduval—Entomology of the Voyage of the French Surveying ship the Astrolabe;" Guerin—"Zoology of the Voyage of the Coquille;" and Germar—"Linnean Entomology" (1848); Angas—"South Australia Illustrated," 1847, figures on plate 48, twelve species of orthoptera, neuroptera and hemiptera, on plate 51 thirty-one species of coleoptera, and plate 37 is devoted to lepidoptera.

Moreover Mr. G. Masters has afforded great aid to the student in the orders Lepidoptera and Coleoptera by the publication of catalogues of the names of all the described species known to inhabit Australia, accompanied with a reference to the description of each.

Order Lepidoptera.—His "Catalogue of the Described Diurnal Lepidoptera," 1873, contains the names of 202 butterflies, and of these it would seem that only seven are recorded as inhabiting this province. Mr. G. F. Angas in his "S. Australia Ill.," figures on plates 37 seven species of Diurnal Lepidoptera, two of them are unnamed, one of which has probably been described by Felder, and as three of the species are not recorded for South Australia by Mr. Masters, the total number of butterflies known to occur with us is ten. Mr. Angas has represented on the same plate sixteen species of moths. Mr. Wallace ("Distribution of Animals," vol. 1, p. 404), states that in South Australia there are *less* than thirty-five species; but does not give the names of the species.

ORDER COLEOPTERA.—The "Catalogue of the described Coleoptera of Australia," by Masters (1871-1874), enumerates 5,607 species of beetles of all kinds, which are distributed among 57 families; of these 592 species, belonging to 36 families, occur in South Australia. The largest groups represented by our Coleopterous fauna are—Carabidæ, 103 species, being 11·8 per cent. of the total of Australian species; Buprestidæ, 59, or 17·6 per cent.; Curculionidæ, 122, or 14·0 per cent.; Cerambycidæ, 111, or 27·0 per cent.; Tenebrionidæ, 48, or 11·7 per cent.

Some of the families are very disproportionately represented; thus we have only 1 out of 78 Australian Staphylinidæ, and 11 out of 157 Elateridæ, but 26 out of 60 Anthicidæ. This circumstance is explained partly by the fact that the Australian species of certain families have not been monographed, and partly because collectors have not interested themselves about certain others.

A large number of our South Australian beetles will be found described in—"The Entomologist," by Newman (1842); "Transactions Entomological Soc. of New South Wales," by Macleay, two vols.; "Notes on Australian Coleoptera," by Castelnau, Trans. Roy. Soc. Victoria, vol. 8, pp. 30-38 and 95-225 (1867-68).

"The Journal of the Linnean Society of London" contains the following papers relating to Australian Coleoptera:—"Descriptions of new species of Stigmodera," by E. Saunders, vol. ix., 1867, two plates. This paper contains the characters and figures of fifty undescribed species of the genus *Stigmodera* from Australia; five of the new species occur at Adelaide. "Contributions towards a knowledge of the Curculionidæ," by F. Pascoe, part I., vol. x., 1869, three plates. Seventy-nine Australian species are described, about one-half figured; fifteen of the species are recorded from South Australian localities. Part II., vol. xi., 1871, four plates, contains descriptions of twenty-one new Australian species, four of which are stated to have been collected in this neighbourhood. Part III., vol. ix., 1872, four plates, contains descriptions of thirty-two unrecorded Australian species, three of which are South Australian. In the appendix to (†) "Captain King's Coasts of Australia, 1827," will be found a "Catalogue of Insects," by W. Sharp MacLeay, including descriptions of new species, but unaccompanied with illustrations, and without localities. The Coleoptera number 108, the majority of which are new. (†) "Discoveries in Australia," by Commander Stokes, two vols., 1846. An appendix to vol. I. of this work is devoted to "Descriptions of new or unfigured species of Coleoptera," by A. White. Eightee species are illustrated by two plates, and described.

Additions to the list of South Australian Coleoptera have been made known through the following papers:—Mr. J. S. Baly, (†) "Annals and Magazine of Natural History," November 1877, describes thirteen new species of Phytophagous beetles from Australia—four of which are from Gawler, one being the type of a new genus; and in the number for January, 1878, two species of Chrysomelidæ. The same author has communicated a similar paper to the "Journ. Linnean Society," vol. xiii. (1878), in which seven new species obtained from Gawler and Adelaide are described.

(*) The British Museum Catalogues of the Longicornia, by Mr. F. Smith, 1853, 1855, 10 plates, make mention of 102 species inhabiting Australia. In 1859, Mr. F. P. Pascoe, to whom our knowledge of the Australian longicorn bettles is almost entirely due, published a list of the 259 Australian species of this favourite group in vol. ii. "Journal of Entomology," illustrated by two plates; and seven years after in the (†) Proc. Linnean Soc., vol. ix, 1866, he furnished another list which contains nearly 500 species. He writes:—"If we take into consideration the economy of these insects, their usually short lives in the perfect state, and their attachment to certain trees in which their larvæ have fed, confining their distribution to very narrow limits, we can scarcely avoid drawing the conclusion that we are still very far from having a complete list." Of the new species described in the latter paper fourteen are South Australian, from the neighbourhood of Gawler, collected by Mr. Odewahn. This brings up the total number of recorded South Australian species to 126. In a supplementary paper in the same volume, Mr. Pascoe adds seventeen new species, one of which is South Australia, and in the "Annals and Magazine of Natural History," May, 1867, four new forms are described.

Order Hymenoptera.—Mr. F. Smith in the British Museum "Catalogue of Hymenopterous Insects," 7 vols., 47 plates, 1853-1859, gives a complete list of all the known species of bees, hornets, wasps, ants, and their allies with references to the synonyma, and describes many new species, the majority of which are illustrated by lithographic plates. The number of Australian species recorded is 533, and of these 71 inhabit this colony. For the solitary and social wasps the chief source of information is Saussure's monograph of the family, "Etudes s. la Famille des Vespides," 3 vols., 1852–56, which contains figures of all the Australian species, excepting the six new species described by Smith in the above-named catalogue. The same author, in (†) Brench-

ley's "Cruise of H.M.S. Curaçoa," 1873, describes some new Australian species, and gives diagnoses of some previously known, 18 in all, which are beautifully represented by three coloured plates.

ORDER NEUROPTERA.—The number of described species of this order known to occur in South Australia is only ten. The chief work in which species are diagnosed are :—King's "Coasts of Australia ;" Appendix by W. Sharp MacLeay ; (five dragonflies catalogued, three new.) Adam White, in "Eyre's Exped. into C. Australia," describes and figures a neuropter, probably South Australian. (*) "Catalogue of Neuropterous Insects," by F. Walker, 4 parts, 1852-53, contains descriptions of eight South Australian species. (*) "Catalogue of Termitina," by Dr. Hagen, 1858 ; "New Genera and Species of Neuropterous Insects, &c.," by McLachlan, in (†) "Proc. Linnean Soc., vol, ix, 1866 ; and "On a Systematic Classification of the Ascalaphidæ.' by the same author, loc. cit, vol. xi., 1873. In the latter part specific characters are given of four South Australian species, two of which had been previously undescribed.

ORDER DIPTERA.—(*)"List of Dipterous Insects"—F. Walker, seven parts, 12 mo., 1848-1855. This work contains the names of 338 Australian species of flies, 184 of which are described as new kinds. South Australia is represented by eight species only, four of which are new ; but Mr. Tepper informs me that he has 80 species of the order in his local collection. Frequent reference is made by Mr. Walker in connection with the Australian forms to Macquart's. Diptera Exotica and Supplement.

ORDER ORTHOPTERA.—The chief works relating to Australian insects of the family of the cockroaches are :—Saussure, Revue Zoologie, vol. xvi., and Melanges Orthopterologiques (1863-72); Wattemoyle, Noveau Systeme des Blattaires; (*) Walker, Catalogue of Blattariæ, 8-vo., 1868, and Supplement 1869.

The two volumes by Mr. Walker contain all the recorded species up to date, 111 of which are Australian. Diagnoses are given of forty-eight species, five of which are from this province ; the total South Australian forms are eight.

The "Catalogue of Dermaptera Saltatoria," F. Walker, five vols., 8-vo., 1869-1871, deals with the remaining families of the order Orthoptera, and includes the crickets, grasshoppers, locusts, &c. The number of Australian species is 160, of which 124 are fully described in that work ; for the rest reference is given to Serville, Hist. Orth., and Erichson's "Archiv f. Naturgeschicht." The number recorded from South Aus-

tralia is thirteen, making a total of twenty-one orthopterous insects. Mr. Tepper reports that sixty are known to him.

Prof. Wood-Mason, Ann. Mag. Nat. Hist. July 1877, describes and records new orthopterous insects of the families Phasmidæ and Mantidæ from Northern Australia.

ORDER HOMOPTERA.—165 is the number of Australian Cicads and their allies catalogued by Mr. F. Walker (*), "List of Homopterous Insects," four parts, eight plates, 12 mo., 1850-1858; forty-two of these are referred to by name, whilst 123 are fully described; in the former are two South Australian species, figured in Eyre's expedition; and in the latter are nine, obtained at Adelaide. Though seven species of thrips and scale insects are known to occur in Australia, yet so far as regards published sources of information, no South Australian species has been determined.

ORDER HEMIPTERA.—Much of our information respecting the Australian examples of this order is contained in the works of Dallas and Walker, published by the British Museum authorities under the misleading titles of (*) "List of Hemiptera," 12-mo., part I., 11 pl. (1851); and part II., 4 pl., (1852) and (*) "Catalogue of Hemiptera Heteroptera," 8 vols., 8-vo., 1867-1878. The latter work by Walker, is supplementary to and in continuation of the former; taking the two together, there are recorded 298 species belonging to Australia; of these, forty-four are South Australian. In Dallas's List ten South Australian species are described, and in Walker's Catalogue nineteen; for the remaining thirteen we need to consult no less than eight separate publications. These are:—Donovan, Insects of New Holland; H. Schaff, Wanz. Insects; Erichson, Archiv f. Naturg., vol. 8; Guerin, Voy. Coquille; Hope, Catalogue (1837); Serville Hist. Hemiptera; Westwood, Trans. Entomol. Soc.; Stal, Ofv. K. Vet. Ak. Forh, XXIII. Some of the types of the new species from this province form part of the collection in the National Museum at Melbourne.

CLASS MYRIAPODA.—The British Museum (*) "Catalogue of the Myriapoda" (1856) gives a complete description of all the genera and species of centipedes, millepedes, and their allies known to exist. Of the 23 Australian species therein recorded, only one is with certainty known to be South Australian.

CLASS ARACHNIDA.—In Koch's (†) "Arachnides Australiens" we have a masterly monograph of Australian spiders. The work was commenced in 1871, and up to the end of last year 21 fasiculi of 968 pages and 84

plates in quarto have been issued. In addition to Continental examples of the class, there are described spiders from New Caledonia, New Guinea, New Zealand, and some of the Polynesian Isles. The chief materials have, however, been obtained from the north-east and eastern parts of Australia. South Australia has furnished only one species (*Lycosa lacertosa*, p. 952, t. 82, f. 6); it is from Adelaide. That only one species of spider is recorded from this Province will appear most extraordinary; but the knowledge of the existence of many forms and of remarkable variety proves most conclusively that this department of zoology has been lamentably neglected by us. The difficulties attending their preservation can no longer be an excuse for overlooking these creatures; and the study of their habits, which I believe to be in the highest degree interesting, especially the wonderful mimicry of some and the intelligence exhibited by others, has at all times been accessible to us. There cannot be a doubt that the field of observation is an extensive one, and as soon as the student shakes off a natural antipathy to spiders he will find in them much to encourage him to devote a large share of attention to these much maligned animals.

Directions for the preservation of arachnids will be found in Mr. O. P. Cambridge's paper "On some new genera and species of Araneidea" —Annals and Magazine of Natural History, January, 1877—which, moreover, contains the description of another South Australian spider (*Agaupes subtristis*), the type of a new genus, obtained at Adelaide. Five other Australian species are here described. Further, supplementing the great work of Koch, is a paper by H. H. B. Bradley on the araneides of the Chevert Expedition, Proc. Linn. Soc., N.S W., vol 2.

Class Crustacea.—Milne Edward's "Histoire Naturelle des Crustaces," 3 vols., 1834-41, is absolutely indispensable to one occupied in the study of Crustaceans. And though I am not aware of the publication of any work specially devoted to this branch of Australian Zoology, yet several Decapodous Crustaceans which inhabit the shores of this continent are described and figured in the following works :—

Dana, "U. States Exploring Expedition, Crustacea," (1852-53.)

† Miers, "Zoology of the Erebus and Terror, Crustacea," (1874). In this work twenty-three species of crabs, soldier crabs, and shrimps, are described from New Zealand, Australia, and the South Seas; twenty-two of them are figured.

* Miers, "Catalogue of New Zealand Crustacea," (1876), three plates.

† White, in Juke's Voy., H.M.S. Fly (1847), describes a new genus, and five species of Australian crabs; and in Voy. of H.M.S. Rattlesnake (1852) two new species of Decapodous Crustaceans.

† Miers, "Revision of the Plagiusunæ," An. and Mag. Nat. Hist. Feb. 1878, gives, a synonymic list, with brief diagnoses and remarks of the species of this small and well defined group of the Grapsoid Brachyurous Crustaceans; four Australian species are referred to.

Bell, "Catalogue of Crustacea," Part I, Leucosiadæ, Trans. Linn. Soc., vol. xxi., 1855, describes and figures seven Australian species of the family, One species, *Philyra lævis*, inhabits Port Adelaide. The only other references to South Australian Decapods that I know of are made by Gray in Eyre's Exped. Central Australia, in writing upon the species of fresh water crayfish of Australia and Tasmania.

The following may advantageously be consulted :—

White, "List of Crustacea," Brit. Mus. Cat. (1847.) De Haan, "Fauna Japonica" Crustacea (1850.) Heller, "Voy. Novara," Crustacea (1865).

Sub-class Amphipoda. In the (*) "Catalogue of Amphidous Crustacea,' by Spence Bate, 8 vo., pp. 400, 59 plates, 1862, the author brings together in a systematic arrangement all the Amphipods that were then known to science. Descriptions and figures are given, taken from specimens in the British Museum; but where examples of species have not been procurable, the description by the author of the species has been followed accompanied by copies of figures when illustrated. The number of Australian species is eleven, distributed as follows :—Seven in New South Wales, one common to New South Wales and South Australia, one Tasmanian, one South Australian, and one locality unknown. The two S. Australian species *Allorchestes Gaimardi*, M.Eds., and *Amphithoe Australiensis*, Bate, are marine, whilst a fresh water Amphipod, possibly the *Gammarus Verreauxi*, M.Ed., described from New Holland, and one or two of the aberrant forms of the sub class, at least, await identification.

Order Isopoda.—Many species of this order inhabit our shores, and a few land forms are not unfamiliar objects. I do not know any special work treating of them; but some information respecting them may be gleaned from the general works given under 'Crustacea.'

Of Phyllopodous Crustaceans, three species have been exhibited before this Society, one *Lepidurus Angasi*, Baird, will be found described and figured in Proc. Zool. Soc., 1866. The others a *Branchipus* and an

Estheria have not been identified. A new species of the former from Peak Downs, Queensland, is described in the "Journals des Museums, Godeffroi," No. 12.

The only book information that I am in possession of respecting the Ostracodous Crustaceans of Australia is that comprised in the three following papers by the Rev. R. King in † Proc. Roy. Soc. of Tasmania. "On some species of Daphniadæ found in N. S. Wales," vol. ii., part ii., p. 243. et seq. (1853) five plates. "On some Australian Entomostracans," id. p. 253, three plates, and vol. iii., pt. 1, 1855. In these papers thirty-six species are described all with new specific names, and one new genus is instituted for two of them.

The (†) "Monograph of the Sub-class Cirripedia," by C. Darwin,—published by the Ray Society, represents the present state of our knowledge of these Crustaceans, though twenty-four years have elapsed. In Part I Lepadides, 10 pl., 8 vo., 1851, the Pedunculate Cirripedes are described; eight are recorded from Australia, three of which are peculiar, one *Ibla quadrivalvis*, being confined to St. Vincent's Gulf, Part II., 30 pl. (1854) is devoted to the Balanidæ or acorn shells twenty-two inhabit the Australian shores, eleven of which are peculiar the South Australian species are two of *Acaste*.

Class Annelida.—Baird, W. "New species of Tubicolous Annelides," Proc. Linnean Society, Vol. viii., three plates, 1864. In this paper are described new species of tube-building worms which form part of an extensive collection of annelides in the British Museum. The family Serpulidæ was established by Linnæus, in which he included the Molluscan genus *Vermetus*, the shelly tubes of which bear a close resemblance to those of *Serpula*. Dr. Baird shows that a more detailed knowledge of the animals is necessary to fix them with certainty in their systematic position; thus an examination of the animal inhabiting the tube, named *Vermetus cariniferus*, by Gray, which inhabits our coasts, has resulted in its removal from the molluscan class of Gasteropods to the family Serpulidae of the Class Annelida. The species described include four from New Zealand and three from Australia.

Baird.—"Contributions towards a monograph of the species of Annelides belonging to the Aphroditacea," op. cit., vols. viii-ix. The Aphrodites include the sea mice, many of which are remarkable for their size and from being covered with brilliantly-shining and splendidly irridescent hairs. The only South Australian species of the family recorded is *Aphrodita Australis*, Baird, which was obtained at Port

Lincoln, and is 3½ to 4 inches in length. This paper gives a list of the known species and descriptions of new ones. Thirteen species out of a total of 146 inhabit the seas of Australia and New Zealand. The chief works referred to for Australasian aphroditacea are—Kinberg, "Ofversigt af Kongl. Vetenkaps — Akademiens Forhandlinger" (1855), and "Fregatten Eugenies Resa;" and Schmarda, "Neue Wirbellose Thiere."

Baird.—"Contributions towards a Monograph of the Amphinomacea," op. cit., vol. x., 3 plates, 1868. A list of the known species is given, and eight Australasian species are recorded, four of which are described as new.

Baird, "Remarks on several genera of Annelides belonging to the group *Eunicea*," op. cit., vol. x. (1869). The animals of this group are the marine worms, so remarkable for their great length. Five Australian species are mentioned, three of which are described for the first time.

Baird, op. cit., vol. xi (1873), describes some new species of Annelida and Gephyrea, chiefly from Patagonia and New Zealand.

Quoy and Gaimard make known two species of Turbellarian worms.

Class Entozoa.—Mr. G. Krefft has written an octavo work on "Australian Entozoa," which contains a list of all the intestinal worms observed in Australia, and descriptions of new species, illustrated by three plates.

Class Echinodermata.—Order Echinoidea.—Our knowledge of the sea urchins of Australia is embodied in a paper by the Rev. J. E. Tenison Woods, entitled "The Echini of Australia"—Proc. Lin. Soc. of N.S.W., 1877. The author, at the request of Mr. Macleay, undertook to describe the Echini collected by him in the Chevert Expedition, and took the opportunity of collocating isolated observations on the distribution of this group of marine animals in the Australian seas, except the western portions. His list contains 56 species, three of which are new to science. He divides Australia into three marine provinces, the north-east, the east, and the southern. Respecting the southern, which concerns us most, he writes that it has a peculiar fauna which possesses what are called the truly Australian genera, such as *Amblypneustes, Holopneustes, Microcyphus, and Linthia*; and further remarks—"I cannot find much connection between our tertiary fossil fauna and what we see in the present Australian seas." Three species are common to both, while not only are Australian genera remarkably absent, but even a whole sub-order—the Desmostichia is scarcely represented at all in our fossil formations. In fact, the separation between our tertiary and recent Echini is almost

complete. A very few species and a small number of genera are common to the tertiary and recent periods, but our commonest species are not even generically represented." Thirteen species are stated to inhabit our shores, and in a supplementary paper, op. cit., 1878, another one is added.

The chief works relating to the Australian branch of the subject are :(†) L. Agassiz, "Monographies des Echinodermes," 1838-41; A. Agassiz, "Revision of the Echini," 1873; (*) Gray, "Catalogue of the Recent Echinida Irregularia," 1855.

Other Orders of the Echinodermata.—A general work, combining the results of previous fragmentary knowledge on the Echinoderms is the(†)"Histoire Naturelle des Echinodermes," by Dujardin and Hupe, 1862. A large number of Australian star-fishes was described by Gray in an appendix to Jukes's Voyage of the Fly, the majority of which was later figured by the same author in his † "Synopsis of Species of Starfish," 16 plates, 4 vo., 1866. † Muller and Troschel's "System der Asteriden," 1842, is a monograph of the then known species of starfish and brittle stars (illustrated by 12 plates; some Australian species are mentioned. Quoy & Gaimard, "Voy. Astrolabe," describe three species of Australian holothurians.

Class Actinozoa.—Some South Australian Madreporariæ and Actiniæ are described in the "Voyage de l'Astrolabe", and in (†) Ellis and Solander, "Natural History of Zoophytes" (1786), all of which have been cited by MM. Edwards and Haime (†) "Histoire Naturelle des Corallaires," 3 vols. and atlas (1857-60). The position of the coral fauna in temperate Australia is stated by the Rev. J. E. Tenison-Woods to be as follows—"Up to this time all these discoveries (those made by deep-sea dredgings) have had but little effect on the knowledge of the Australian forms. I may say that the Extratropical Madreporaria of Australia have been literally untouched. Yet a special interest is attached to them on account of what has been made known through geological researches." The above quotation is from a paper "on the Extratropical Corals of Australia," illustrated by three plates, Proc. Linn. Soc. N.S.W., 1877. We have to thank Mr. Woods for throwing light on the subject and science is deeply indebted to him for what he has effected in this and other departments of Australian Natural History. In his paper eleven new species are described, and it has been found necessary to institute two new genera for two of them. From his knowledge of the fossil forms he has been enabled to show that some of our tertiary species still

exist in the Australian seas. Only three species of corals are known to inhabit our shores; one of them is described as new by Mr. Woods.

The Alcyonarian Polypes inhabiting Australian seas are, according to Gray, nineteen in number; most of them are described in two of the British Museum publications:—(*) Catalogue of the Pennatularidæ, and (*) Catalogue of Lithophytes, by J. E. Gray, 8vo., 1870.

Class Hydrozoa.—Busk, in (*) Voyage of the Rattlesnake, records and describes thirty-one species of Sertularian Zoophytes from Australia. Thirteen are from Bass's Straits and north coast of Tasmania, the rest are tropical forms. The following works should also be consulted:—(†) Johnston's "British Zoophytes"; Allman's "Monograph on Gymnoblastic Hydroids"; Hutton, "New Zealand Sertularians", Trans. New Zealand Inst., vol. v., 1872; Coughtrey, "New Zealand Hydroids", id. vols. VII. and VIII.

BOTANY.

Phanerogamic Botany.—Australia had not long been colonized before its flowering plants began to attract scientific attention, and during the first half of this century such eminent botanists as Robert Brown, Solander, Sir Joseph Banks, Cunningham, Labillardiere, Sir Joseph Dalton Hooker, Bidwell, and others, laboured on the spot to elucidate the Botany of Australia. In our day much has been done by other eminent men to further the work of their predecessors. I need only allude to the labours of Baron von Mueller and Bentham as instances; and South Australia has been distinguished by the researches of our Dr. Schomburgk. The sum of all these labours is the (*) "Flora Australiensis" by Dr. Bentham, the seventh and concluding volume of which has just been issued. In the preparation of this work the author has been most ably assisted by Baron von Mueller and others, who, from their knowledge of the living plants, have enabled Dr. Bentham to obviate those disadvantages he necessarily laboured under.

Dr. Schomburgk has given us a Synopsis of the Flora of South Australia, which has been mostly compiled from the abovementioned work, and an able dissertation on the physiognomy of the vegetation of this colony ("Flora of South Australia" in (*) Harcus's "South Australia," 1876.) Though we may safely say that the flora of this province has been well determined, for it must not be forgotten that the early botanical investigations of Baron von Mueller were carried on in our midst, yet, to quote the words of Dr. Schomburgk, "by the constantly-occurring new discoveries, especially in the central parts of South Australia, the

synopsis cannot be considered quite complete." Indeed, a complete revision of the latter part of Dr. Schomburgk's Synopsis is rendered necessary by the publication of Vol. VII. of the Flora Australiensis. A reduction in the number of species is obtained by suppression of names, regarded as synonymic by Bentham, and by expurgation of others not known to be South Australian; whilst on the other hand the list is largely increased by species not previously known to occur within our boundaries. That Dr. Bentham does not, however, fully state the extent of our knowledge is clear when he omits such familiar plants as *Typha angustifolia*, *Lemna trisulca*, and some others, from the South Australian lists. Comparing the two sources of information, I find that the order Liliaceæ is reduced from 25 species to 14, but five others are added; Juncaceæ, from 25 to 14, nine new; Xrideæ, from six to one; Commelynaceæ, Aroideæ, Typhaceæ, Lemnaceæ, and Eriocauleæ, which we thought to contain 15 South Australian species, are, according to Bentham, unrepresented; Alismaceæ is reduced from two to one species, but 11 are added; Restiaceæ, from eleven to four, but six are added; Cyperaceæ, from thirty-three to eighteen, but thirty-four additional species are given, nine belonging to Central Australia; Gramineæ is reduced from eighty-three to thirty-nine, but sixty-five are added, making a total of 104 grasses, thirty-two of which are Central Australian. The lycopods and their allies are only represented by two species, where we were believed to possess eight; the ferns are reduced from thirty-five to sixteen, but *Dicksonia antarctica* is the only addition. Of the 243 species catalogued by Dr. Schomburgk 134 are retained, to which 136 are added, making a total of 270 species of the orders from Liliaceæ to Filices.

Despite the efforts of the many able men that have laboured in this department of Australian biology, I think that the field is not exhausted; and though we cannot expect to be rewarded by our search for undiscovered species, yet the habits of known plants, of which we have a very limited knowledge, afford a very favourable opening for further researches. The modes of fertilization of our native plants, and the mutual dependency of certain plants and animals, are subjects about which very little is known. A reader of Darwin's "Fertilization of Orchids," or Sir John Lubbock's "British Wild Flowers," cannot fail to be incited to a practical examination of the phenomena therein described; and be it known that several of the orders to which especial interest is attached are abundantly represented in this colony. Dr. Bentham, who has investigated the stigmatic

apparatus of *Goodenoviæ*, one of our largest orders, especially commends to the attention of Australian botanists the manner in which impregnation is impeded or facilitated in this group of plants. He writes :—"As far as can be judged from dried specimens, there seems to be considerable diversity in the impediments opposed by the structure of the parts, as well as in the contrivances provided for overcoming these obstacles. The progress of development, however, can only be watched on the living plant; and it is in order to call to the subject the attention of any observers who may be resident in Australia that I lay before the Society the peculiarities which I have observed."—Journal of the Linnean Society Botany, vol. x., p. 204, 1868. The same author makes a similar appeal in his paper "on the Styles of Australian Proteaceæ," l. cit. vol. xiii., p. 58, 1871. As his observations on the peculiar fecundating apparatus of the plants of this order, which includes our common Banksias and Grevillias, were made almost exclusively on dried specimens, "they will require to be supplemented, and probably in several instances corrected by those who can watch the process of ripening and mutual action of the anthers and stigma on the living plants."

The distribution of our native plants, especially in relation to hydrographical and geological conditions, requires working out; and little is known respecting their medicinal uses. Economic botany has, however, received much attention at the hands of Dr. Schomburgk, and the successful efforts made by that gentleman to acclimatise useful and ornamental plants have laid the country under a debt of gratitude to him. The Botanical Garden needs no advocate; and its Director has not been unmindful of the claims of systematic botany to be adequately represented; yet it lacks one important adjunct, namely, a museum of economic botany, devoted to the illustration not only of the raw materials industrially valuable, but also of steps in the processes by which they are rendered available for our use.

Cryptogamic Botany.—The present state of our knowledge of the Orders Filices, Lycopodiaceæ, and their allies will be found in volume VII., "Flora Australiensis." From the circumstance that many of the Australian fungi are either identical with European species or so nearly allied to them, the peculiar Australian forms being few in number, it cannot be hoped that any satisfactory determination of them can be undertaken in this country, though it is no bar to extended observations on the recorded species or to the search for undiscovered ones. The Rev. M. J. Berkeley has given a list of "Australian Fungi, received principally

from Baron F. von Mueller and Dr. R. Schomburgk ;' Journ. Lin. Soc., vol. 13, pp. 155, et seq., 1872. The number catalogued is 235, of which 43 are South Australian.

Marine Algæ.—Figures of many Australian seaweeds are given in Harvey's "Nereis Australis," and in Hooker's "Flora of New Zealand' and "Flora of Tasmania ;" but in (†) Harvey's "Phycologia Australica," vols. 5, 8vo, 1858-1863, we have a more comprehensive history of this class of Australian plants. In this work the more characteristic sea-weeds are illustrated by coloured drawings, accompanied when necessary with such magnified dissections as will enable any one possessed of a microscope to refer with certainty the figure to the plant which it represents. The number of plates is limited to 300, but at least one species of every genus is figured. The species which are figured in earlier works are not repeated in the Phycologia Australica, except in the case of types of forms which could not be omitted without injury to the scope of that work. A synopsis of all known Australian algæ is given; and the number of actually known species dispersed along the Australian coasts is 799; of these we appear to have 138 on our shores. The work lacks method in the arrangement of the descriptions, and the omission of a conspectus of the genera is a serious defect.

GEOLOGY.

The general geology of South Australia is represented on a (†) "First Sketch of a Geological Map of Australia," by R. Brough Smyth, 1875, which embodies the labours of Selwyn and Woods and the inedited observations of our Survey Department and of some explorers. The country south of Lake Eyre is shown to be occupied by Silurian, Tertiary, and Igneous rocks. Though the broad features seem to be pretty correctly pourtrayed (for as the scale is only 110 miles to an inch no accurate definition can be expected), yet extensive patches of tertiary rocks are known to exist where Silurian is shown, and in the Western District protrusions of the latter are omitted. Moreover, no distinction is drawn between our older and newer tertiaries, which are so widely separated from each other in point of time ; and also the two unconformable sets of the Palæozoic rocks, which were described by Selwyn, are not separately coloured.

The salient points of our geology about which we want to have accurate information are :—The metamorphic or igneous character of the granites; the order of succession of the fundamental rocks ; the age of

the newer palæozoics; the distribution of the upland conglomerates and ferruginous sandstones of the foot hills of the Adelaide Chain, and proofs of their supposed miocene age and fresh-water origin—the same in regard to the "desert sandstones" of the interior; the correlation of the marine older tertiaries of the various disconnected tracts; extended observations on glacial signs, and the probable connection of the newer drift deposits with them; and lastly, accurate measures of recent elevation of the land.

I must not attempt a history of South Australian geology, but will content myself with a list of the works relating to the subject.

1814. Flinders, "Voyage Terra Australia."

1843.* Sturt, "Two Expeditions into South Australia."

1846.† Jukes, "Sketch of the Geol. Structure of Australia," Brit. Ass. Reports, p. 68.

1846. Burr, "Remarks on the Geology and Mineralogy of S. Australia" (Adelaide).

1859. Selwyn, "Geol. Notes of a Journey in S. A." Parl. Report No. 120. Five plates of sections and map.

1860. Burr, "Geol. of a Part of S. Australia." Quart. Journ. Geol. Soc., vol. xvi.

1860. Woods, Geol. of the Southern Part of S. Australia." Quart. Journ. Geol. Soc., vol. xvi.

1862. Woods, "Geological Observations in S. Australia." 8vo, 404 pp. (London).

1866. Woods, "Report on the Geology and Mineralogy of the S. Eastern District." 8vo, 33 pp., map and two plates of sections (Adelaide).

1866. Hanson, "Geology of the South-East and Port Elliot Districts." Phil. Soc. of Adelaide.

1866. Woods, id. in reply to the above.

1872. Ulrich, "Mineral Resources north of Port Augusta." Parl. Rep. No. 65, pp. 23, 9 plates of sections and map.

1875. Higgs, "Remarks on the Mining District of Yorke's Peninsula." Trans. Roy. Geol. Soc. of Cornwall, vol. 9., part 1, pp. 122-131.

1875. Smyth, "First Sketch of a Geological Map of Australia".

1877. Tate, "Strata exposed in the Government Well, Murray Plains." Geological Magazine, Nov., 1877.

1878. Tate, "Note on the Correlation of the Murray Tertiaries" (pub. herewith).

A most valuable addition to the geological literature of Australia is the recently-published "Remarks on the Sedementary Formations of New South Wales," by the Rev. W. B. Clarke, F.R.S. This work is an index to the immense service rendered by that veteran to geology generally, although more particularly confined to the palæozoic rocks of New South Wales, to which he devoted forty years of his life and his remarkable talents.

MINERALOGY.

This important branch of South Australian Natural Science will be separately dealt with by Mr. S. Higgs, F.G.S.

PALÆONTOLOGY.

The known fossiliferous rocks of South Australia proper belong to the older and newer tertiary period. The fossils of the latter are closely related to the existing fauna, whilst those of the former make part of a large extinct fauna and flora, and which must be studied in relation to those of the equivalent strata in Victoria and Tasmania. Great advances have of late been made towards a better knowledge of the older tertiary fossils of these two colonies, and the chief sources of information are—

McCoy, "Decades of the Prodromus of the Palæontology of Victoria," I-V., 1874-78. The fossils described and illustrated are chiefly tertiary, belonging to various classes of animals.

Mueller, "Observations on New Vegetable Fossils," 1874.

Woods, "On some Tertiary Fossils from Table Cape," 2 pl., Trans Roy. Soc. Tasmania, 1874.

Woods, "Notes on the Tertiary Fossils of Tasmania," loc. cit., 1876.

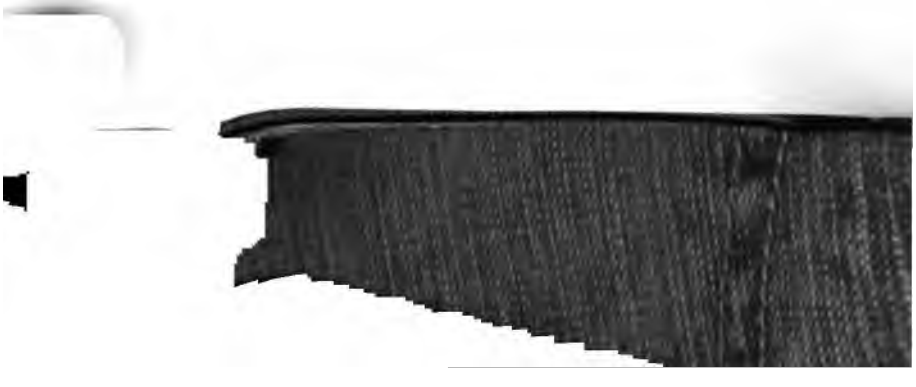
South Australian Tertiary Fossils have been specially dealt with in the following papers and works :—

The Rev. J. E. Woods described and figured five species of pectens from Mount Gambier, in Trans. Phil. Soc. of Adelaide, 1865. This was followed in the same year by another on the Brachiopoda from the same

locality. Five species are figured and described. Additional species are made known by Etheridge in a paper "On some species of Terebratulina, Waldheimia, and Terebratella from Mount Gambier and the Murray Cliffs. (Annals and Mag. of Nat. Hist., 1876, 2 pl.) This paper gives descriptions of five species of fossil palliobranchs, which are illustrated by well executed drawings contained in two lithographic plates. Two species are decidedly new, *Terebratulina Davidsoni*, and *Waldheimia Taylori*, but a third species described as new under the name of *W. Gambierensis* is identical with *W. grandis*, Woods. The other species illustrated are *W. Garibaldina*, Davidson, and *Terebratella compta*, Sow. The Rev. J. E. Tenison Woods describes and figures some Australian tertiary brachiopods (Trans. Roy. Soc. N. S. Wales, 1877), and notes the occurrence of two of them in the South Australian deposits. In a paper which I have prepared the S. Australian fossil species, twenty-two in number, are treated in a monographic form.

The echinodermal fauna of the Australian tertiary rocks is one of remarkable interest, and has received attention from not a few palæontologists. The Rev. J. E. Tenison Woods figured and described three species of sea urchins from Mount Gambier in the transactions of this Society, published in 1866; one of the species had been previously made known. The next contribution to the subject was by Dr. Laube, (†) "Ueber einige fossile Echiniden von den Murray Cliffs in Sud Australien" (Sitz. d. k., Akad. d. Wissench, Wien, 1869), who describes and figures as new eight species, but two of these had been made known by Mr. Woods. Next R. Etheridge, jun., in Quart. Journ, Geol. Soc., 1875, gives a *resumé* of all that had been published on the S. Australian fossil tertiary echinoderms, but overlooked the important communication thereon made to this Society by Mr. Woods, and by means of drawings illustrates certain detailed characters which were not noted by Laube. Dr. Duncan, in the same Society's journal for 1877 describes eleven new species from the Australian tertiary deposits, and identifies three living species as met with in a fossil state; four species are added to the local list. Collections made by me among our older tertiaries contain most of the species described by Duncan from localities beyond this province.

The last addition is *Salenia Tertiaria*, Tate, described and figured in the Quart. Journ. Geol. Soc., 1877. This beautiful fossil is the subject of some lengthy remarks by Prof. Dr. Duncan in his anniversary address read before the Geological Society of London, February 17, 1878, and in



a series of articles "On the Salenidæ," published in the Ann. and Mag. of Nat. History; in part III., "on a third form of recent Salenieæ, and on the Salenieæ from the tertiary deposits," July, 1878, the learned author writes respecting our species—"It is a fine form of *Salenia*, with all the characters of the cretaceous species, except the distribution of the pores in the ambulacra. In the older *Salenieæ* there is a pair of pores to each ambulacral tubercle, and one intermediate, or in other words, two pairs are in relation to each tubercle. The *Salenia* described by Prof. Tate has but one pair. This is the case with the recent species, so far as is known."

The total number of recorded Echinoderms from our Tertiaries is fifteen, but that is not a moiety of those collected by me from the Murray and Aldinga Cliffs. The chief additional genera are *Pentacrinus*, *Temnechinus*, *Fibularia*, *Laganum*, *Hemiaster*, *Echinobrissus*, *Linthia*, and *Comaster*. The systematic description of the new species is being proceeded with, and I hope soon to have the pleasure of communicating to you a summary of the results arrived at.

The Polyzoa, which constitute so prominent a feature in the Tertiary fauna of South Australia, many of the strata being made up of their *debris*, have been much neglected, and the field is almost untrodden. From their variety of form and the beauty of their ornament they are highly attractive to the microscopist. Professor Busk in 1860 examined a collection from Mount Gambier, forwarded by the Rev. J. E. Tenison Woods, and classified them into forty species of sixteen genera; thirty-six of the former were considered undescribed, and three of the latter being new; but being unaccompanied by descriptions or figures, the list published in the Quart. Journ. Geol. Soc. is of no aid to the student Mr. Woods, in his "Geol. Observ. in S. A.," attached specific names to some polyzoa figured on a lithographic plate in that work; and further added a little to our knowledge in a paper, "Proc. Roy. Soc. of Victoria for 1862." But a more important step was made by him in communicating to the Roy. Soc. of N. S. Wales, 1876, descriptions of "Some Tertiary Polyzoa from Mount Gambier." Thirteen new species are technically described and illustrated by two well-executed lithographic plates; they are *Eschara*, 10 sp., *Pustulipora*, 2 sp., and *Tubulipora*, 1 sp.

The present state of our knowledge of the coral fauna of the Tertiary strata of Australia is given by Mr. Woods in the introduction to his paper published herewith, and that of the S. Australian tertiaries in a supplementary note added by me.

A few gasteropodous shells from the Murray and Aldinga beds are described by me in a paper communicated to this Society.

One other fossil from our rocks has been made known; it is the so-called *Belemnites senescens*, described by myself in the Quart. Journ. Geol. Soc., May, 1877. Its reported occurrence on the Murray is an error, but I have found it at Surveyor's Point, Yorke's Peninsula. Professor McCoy in Decade V. Prod. Pal. of Vict., describes and figures the axis of a zoophyte, under the name of *Graphularia Robinæ*, obtained from the Tertiary strata. He points out its very close resemblance to the guard of a *Belemnite*, and suggests that the so-called discovery of belemnites in the tertiary strata of South Australia is based upon a similar fossil. It is unfortunate for science that Professor McCoy is so oblivious of the labours of others, else he might have taken some pains to clear up the doubt. To me the two fossils are identical, and if the generic name must be changed, then the fossil must, according to the law of priority, be known as *Graphularia senescens*. I have not found a phragmacone, but two specimens exhibit a regularly conical alveolar cavity: and until I can clear away the mysterious nature of this cavity I must hold the question of the systematic position of the fossil as not proven.

A few foraminifera and ostracoda from the Murray and Mount Gambier beds have been determined by Professors Rupert Jones and Brady, the names of which have been published in Quart. Journ. Geol. Soc., 1860, and Geol. Mag., July, 1876.

In conclusion, I may quote the words of my friend, the Rev. J. E. Tenison Woods, who writes, (Pro. Roy. Soc. of Tasmania, 1876):—"It will be seen from this brief sketch that the tertiary formations of Australia have occupied many minds, yet our progress, so far, has been somewhat slow. This is the more remarkable as it has long been believed among scientific men that the development of Australian geology must reveal facts of the utmost importance to science generally." This belief is day by day finding confirmation at my hands; already our Tertiaries are known to contain genera hitherto regarded as of secondary age, and the facts are accumulating which go far to prove that the lower portions of them are older than they have hitherto been regarded, and may indicate a palæontological overlap of tertiary on secondary. So large a number of organic remains have to be arranged, classified, and compared that my labours in this direction are not sufficiently advanced to enable me to submit to you a comprehensive view of the question.

In the department of newer Tertiary Palæontology a very important addition has been made to that fauna which immediately preceded the present one. I allude to the determination made by Professor Owen of the former existence of a large wingless bird on this continent, founded on a tibia obtained in the Mount Gambier District. This bone, he writes, determines beyond question the fact of the former existence in Australia of a wingless or flightless bird of the size of *Dinornis Elephantopus*, but of a genus nearer akin to *Casuarius* and *Dromaius*." It is named *Dromornis Australis*, and indications of its former extensive range in this continent are a femur obtained at Peak Downs, Queensland, in 1869, a pelvis at Goree, near Mudgee, in 1876, and a femur from the Wellington Valley Caves, N. S. Wales. All these bones and the South Australian tibia are considered by Professor Owen to be parts of the same genus if not species. The first to recognise the affinities of this bird was our hon. member, the Rev. J. E. Tenison Woods, and it redounds to his skill as a comparative anatomist that the opinion he expressed has been corroborated by the greatest living anatomist. The original discovery is recorded in his "Report on the Geology and Mineralogy of the South-East, &c.," p. 7, 1866, from which I extract the following:—"In sinking a well on the edge of a swamp fourteen miles N.N.W. of Penola, some bones have been dug up, which were this day (April 25, 1866) recovered by me. They comprise two tibias and two tarso-metatarsal bones, and show them to have belonged to some struthious bird very nearly allied to the emu. . . From the size of the bones it was evidently a larger, heavier, and more clumsy bird. . . . I should propose the provisional name of *Dromaius Australis* for the bird. It is certainly quite extinct, but appears to have been contemporaneous with the natives, for these bones are marked with old scars, one of which must certainly have been inflicted by a sharper instrument than any in the possession of the natives at present; there were, however, fragments of flint buried with the bones, and a native well is distant about fifty yards away."

Professor Owen's "The Fossil Mammals of Australia" will ever remain a classic work, and is the only source of information regarding the extinct kangaroos, wombats, and their allies which are occasionally met with in the superficial deposits and caves of this province, and of other parts of the continent.

OBJECTS OF THE SOCIETY.

The work of the past year warrants the opinion that the two fundamental objects of this Society have been studiously kept before us Its founders were desirous that it should not only afford an agreeable medium of intercommunication to those whose tastes led them to the pursuit of similar studies; but that it should also present a means of illustrating and recording the many interesting natural phenomena which are altogether peculiar to this country, and which it is to be feared would be otherwise in a few years' time irrevocably lost to the records of science. In respect to the latter and more important object, I affirm that the Society has attained a larger measure of results than at any other period of its existence. We shall have removed for one year at the least the reproach made against us by the President of the Linnæan Society of New South Wales in his anniversary address, that South Australia had not contributed anything to the literature of natural history. This success is in part due to the knowledge of the fact that the Society would make every endeavour to renew the publications of its transactions, and thus by guaranteeing that original observations so laboriously effected should be published in a more tangible and permanent form than hitherto, authors have been induced to make this Society the channel of communication with the scientific world at large. The publication of such papers must always be regarded as a matter of necessity, as by such means are we only enabled to keep up friendly relations with learned bodies elsewhere. Though we have been ambitious to secure only original papers for our evening meetings, and have sought to press capable men into the service of the Society, yet we have not unfrequently been reminded of an insufficiency of supply; but we, nevertheless, believe that as the importance and usefulness of the Society are better known, the difficulty in this respect will become less and less. At any rate, our present success can hardly fail to stimulate those who have aided us to fresh exertion, and to encourage those who have not yet assisted us to enter the vast arena of research. A remark made by Mr. J. S. Lloyd on the public estimation in which the Society is held, in his paper on "The present position of the Society," read July 24, 1866, would seem to apply with equal force now as then, and it may be repeated:—"Of course the amount of good effected by the Society has to be taken in some measure upon trust; but we feel that it is to the advantage of ourselves and the colony that attention should be given to science, literature, and art, and because the positive or practical benefit effected by us may not be exactly arrived at, either by weight or measure, we are not the less certain that

it has an existence. At any rate, it is easy to retort upon cavillers that the results would be more generally satisfactory if the Society received more general support." Our numbers have not correspondingly increased with the increase of population, and it has only been in the last two years that any sensible augmentation has been effected; nevertheless, the eighty members of to-day represent a much smaller percentage of the aristocracy of intellect than the sixty members of ten years ago. Is it apathy or indifference that causes so many to stand aloof, who from their profession or position in society should support us by their influence and subscription? Or have our meetings been of so desultory a character as to be repellent? To them I would appeal for the rectifying of the evils of a one-sided policy, for be it remembered that the improvement of any art or science varies directly with the number of intelligent persons engaged therein.

Our Relationship to the South Australian Institute is somewhat anomalous. By the Statutes and Regulations of Incorporation we are—

1. Allowed an independent action.
2. Required to contribute a sum towards the working expenses of of the Institute.
3. Entitled to the use of a room, and also to the services of one or more of the officers of the Institute, at such times and in such manner as may be agreed upon with the Board of Governors.
4. And we have virtually resigned all claim to property actually acquired, for it is enacted that the property of the Society preserved in the room of the Institute cannot be permanently removed nor otherwise disposed of without the consent of the Board of Governors.

Thus on the one hand we pay £12 per annum for the use of a room, and resign all rights to the property we have acquired by gift or purchase; whilst on the other, we receive such trivial assistance as the addressing of a few postal cards once a month, and have possibly the power to recovery penalties; and it would seem also that the Board of Governors "have the power out of the funds placed at their disposal to make a grant to any Society so incorporated in aid of the special objects of such Society." By common consent this Society has been excluded from participating in grants to incorporated Societies, but it is not so expressed by the terms of the Act; and the regulation which gives the

Institution a lien on the property of an incorporate Society is not so unreasonable as it appears, if the property has been acquired by aid rendered by the Institute. We are placed at a great disadvantage by the present arrangements, and I would urge upon your Council the desirableness of securing more equitable ones; and I think you will agree with me that £12 per annum is too large a contribution or share of working expenses, and be it observed that the Society of Arts which has the exclusive use of a room contributes only £5 per annum. Moreover, the lien on our property should be removed, and at once in view of its greatly increased value in the form of surplus stock of our own publications, and of exchanges of publications of other Societies.

It may now be asked—What benefits will the Institute derive from us? Most certainly it should not expect pecuniary ones; and I dismiss the question without argument as it is a universally conceded postulate that it is the duty of the State to aid science. If permitted, I believe that this Society would largely benefit the Institute through its Museum. And with this object in view your Council requested your Representative Governor to move the Board of Governors to cause to have exhibited at our monthly meetings all objects presented to or purchased for the Museum during each preceding month. By this means it was thought that our members would be gratified, and that the remarks elicited and explanations offered would give publicity to the donations and thus serve a good purpose. Moreover, by thus affording those likely to be most interested an opportunity of examining the new acquisitions, the Society's records would keep the memory of them alive, though the objects themselves had been consigned to oblivion in boxes and cellars, there to await the advent of an enlightened Government before again seeing the light. Though the Board concurred with the view of your Council, yet no practical effect has up to the present time been given to the resolution: there may be difficulties which we know not of, but if a Committee were empowered to act all obstacles to the attainment of our object might probably be removed.

OUR PUBLIC MUSEUM.

This reference to the Museum naturally leads me to speak of that public institution. Not only is this Society through its representative at the Board of Governors identified with the Museum, but it has been

instrumental in founding it, for according to Mr. J. S. Lloyd "the formation of a Museum was looked upon as one of the objects of the Society; and no doubt the efforts of the Society in this direction were not altogether without effect, and they have probably borne fruit in the Museum attached to the present Institution." But this Society as the exponent of natural science in this colony may legitimately occupy itself with the question as to whether or not the Museum is fulfilling its proper functions?

A good deal of carping criticism has been indulged in of late in respect to it, but with this I have no sympathy. No man can be found possessing specific knowledge in every department of a general Museum, but I think that if greater facilities were offered to the student in any given branch of our local Natural History, voluntary help of a useful kind would be forthcoming. I propose to examine the question which I have raised from a higher standpoint, and to indicate the chief directions in which reform is needed. By directing your attention to the shortcomings of the existing Museum, I trust that you will use your influence to have them remedied in the Museum of the future. Agitation upon museum reform has been active of late in England, and I have largely availed myself of the opinions of the museum reformers, as I find them to be applicable to our own case; the arrows that I shall shoot are, therefore, not all from my own quiver.

A well-arranged Museum is valuable to the State in various ways. In its highest sense it encourages a love of knowledge for its own sake, apart from any selfish aims; it is a necessary instrument of training in Natural History, and it assists in raising up men possessed of scientific knowledge, to whom appeal may be made for trustworthy information touching the means to be employed for the development of our natural food resources and concerning the character of the natural agents obstructive to that development. A knowledge of the life history of noxious insects enables the entomologist to suggest the right means to keep them in check; and this fact has been fully recognised in the United States, England, France, and Germany. Legislative acts relating to the preservation of birds, fish, oysters, &c., passed by the countries named, have all been dictated by the zoologist. How practically useful and instructive would our Museum be if the rocks, minerals, fossils, and manufactured mineral products of the country were displayed in such a manner as to show in what new directions capital may and may not be invested.

A Museum is, moreover, a means of spreading culture among the intelligent lower classes, and such visitors leave it all the better for having been there, as it is impossible that they should not carry away some sort of idea which otherwise would not have occurred to them. But for the wants of the public a descriptive Guide Book containing elementary inplanations is necessary for the right understanding of the objects exhibited. The effect of museums is to elevate a man's character; and if our Sabbatarian teachers would admit that truth, access to the Museum on Sundays would no longer be denied to those who have no other opportunity in the week, and who do not go to church or chapel. For my part, I am unconvinced by the specious arguments which seek to justify the opening of our Botanic Gardens, and its museum and zoological collection, and the closing of the Zoological Museum on Sunday afternoons.

In our Museum we have not only to consider the wants of the gazing public, but also to provide for the requirements of the special student and to afford materials for the *savant* in promoting original research which functions ought not to be sacrificed for the benefit of mere sightseers. For the former we must have mounted skins of vertebrates showy insects in their perfect stage, prettily-coloured shells, miniature groves of coral, and the like. But Science and Instruction require a great deal more—the animal must be exhibited as far as possible in all its parts, and in all phases of its life; the skin of the kangaroo should be accompanied by its corresponding skeleton; the bird with its nest and eggs; the perfect insect, with its eggs, larva, and pupa; shells, with the animals which produce them, and in every case the station and habit of the animal should be affixed to the specimen.

Collections of typical specimens of this country are absolutely necessary for the advancement of Natural History studies, as the teaching of the elements of the science should be by means of the familiar objects around us. It is a reproach to this State that its Museum so imperfectly —I might say, hardly at all—represents its natural characters; for it happens that the things most characteristic of the country are not thought worth exhibiting; our mineral industries are absolutely unrepresented, if I may except a very few specimens of gold and copper ores. Though I hold that our colonial productions should be most fully represented; yet it is not necessary that all should be exhibited, but nevertheless all should always be open to the inspection of the student.

Our Museum is too small to have any educational value worth naming, and in its present state it teaches too little by attempting too much, and I think it would be far better to exhibit fewer specimens which should fully tell their own tale, than to heap so many together without labels; and because its present resources are so limited, the greatest amount of good will probably be effected by confining attention to the formation of a provincial collection.

The lack of patriotism among those who regulate the affairs of the Museum has been most deplorably shown in some instances that have come to my knowledge—it pains one to recall them. Nevertheless, may I ask why two diamonds, unique as crystals, and which were found within the colony, do not form part of the National Museum collection? Will another, subsequently found and purchased by our Government, find a home with us? Again, why has not that choice collection of our native beetles formed by the late Mr. Odewahn been secured for the country? For, be it known that the Museum does not possess a specimen of the diamond, and that all it has representative of the large coleopterous fauna of South Australia is a small case of dilapidated beetles. If the Museum were the property of this Society, or other body not having adequate means for efficient maintenance, a reasonable answer would be expected not only to such specific questions, but to others that I have already touched upon.

Is the Museum fulfilling its proper functions? I need not press for an answer, as I know that it is the universal opinion that it does not. The chief causes for this may be summarised under the heads of *space, working expenses,* and *management.*

The present Museum accommodation is lamentably deficient, and yet a great mistake is about to be made with that to be contained in the new Institute building, as the space will be only large enough to hold the already exhibited specimens, no provision being made for the display of objects stored away, and of those not already collected. It moreover presents the sad fault of an upper gallery. It would also be well to profit by the example of the United States, who fully recognise the fact that the expense of a grand building starves the museum within.

A well-arranged Museum is of necessity costly; money measures the power of procuring glass-cases and suitable specimens, but as the funds necessary for efficiency should be provided out of the public purse, since it is for the public weal, it is to be hoped that they will be on a scale commensurate with the largeness of the object to be achieved, provided that it is not narrowed down by curtailment of accommodation.

As to management. In the first place, the abnormal connection between the Museum and the Library should be severed, as their interests are somewhat antagonistic. This view is advocated by the press, and in an article in the *Advertiser*, October 23, 1876, it is there urged that "the keeping up of our reading-room in its present state of efficiency, and the formation and development of a free public library, is enough to tax the energies of a single body of men. As for a Museum, we do not think it should be regarded as a part of the Institute at all." It has always seemed to me that it would be an advantage to establish some kind of connection between the Museum and the University—a centre of liberal education where science asserts its proper position—because those who have had most experience in oral teaching will probably be best qualified to assist in its oversight. The principles which are recognised as applicable to education in general apply equally to the arrangement of museums in so far as their educational functions are concerned. The order in which the knowledge of things is best received and retained in the memory is precisely that in which the things themselves were evolved; consequently, the arrangement which in a Museum is best adapted to impart instruction is at the same time that which best records the history of the things exhibited. As the University must have a Museum, and impressed with desirableness of economising space and effort, I suggested to the Council that it should seek to amalgamate the two interests. At a meeting of the Council, held December 15, 1876, two resolutions were unanimously carried, the one affirming the inexpediency of having more than one Museum for the Province, and the other appointing a Committee to confer with the Governors of the Institute about the whole question. The results of that conference have not been publicly made known. But there still remains another course to be followed, by which the evils of having two Museums may be avoided; that is by each one becoming to some extent exhaustive in a special direction.

It may not be too late to direct the attention of the proper authorities to the existing defects, with the view of carrying out the urgently needed reform in connection with the proposed new Museum.

LOCAL AID TO SCIENCE.

While on the subject of National Aid to Science, I may remind you that your efforts to induce the State to undertake a geological survey of the colony, which at one time seemed likely to be crowned with success have proved futile. The reason assigned for not instituting such a department is that of expense. We, who believe that such an organisation

would be able to render considerable service to the country, must feel regret at this determination of the Government, and regard the decision as an instance of false economy. We hope that a survey is only temporarily deferred, and must note with pleasure that a step in this direction is shortly to be made by the investigation of the Hydro-geological character of certain waterless areas.

South Australia has afforded little aid to the scientific examination of the country and its natural products, but it is to be hoped that as natural science asserts its position its claims on the public purse will be less grudgingly allowed than as hitherto. Much of our knowledge has been gained by private enterprise, but there are many investigations which should be undertaken, and which are far beyond the limited means of the scientific man. Take for instance, the exploration of the deeper parts of the sea off our shores, which might be easily carried on during the periodical trips of the Government steamer, and I believe that voluntary scientific aid is available. Apart from the scientific results likely to be gained by such exploration, much knowledge may be acquired relating to deep-sea fish which might prove industrially valuable.

ON THE VEGETABLE FRAGMENTS FOUND IN THE TOMBS AND OTHER MONUMENTAL BUILDINGS OF THE ANCIENT EGYPTIANS.

By Richard Schomburgk, Ph.

Director of Botanic Gardens, Adelaide; Knight of the Imperial Order of the Crown; of the Order of Merit of Phillippe the Magnanimous, and the Order of the Crown of Italy; Mem. Imperial Carol. Leopold Acad., &c.

(Read February 5, 1878).

The large collection of plant-remains in the Egyptian Museum, Berlin, obtained from the tombs and other monumental buildings of the Ancient Egyptians has been re-examined by the late Professor Alexander Braun. The notes of this investigation having been found amongst the deceased's papers, Professors Ascherson and Magnus of Berlin thought it was due to the memory of that great botanist to make them public. My friend Prof. Ascherson has kindly favoured me with a copy of these notes, and I consider them so highly interesting that I could not forbear shaping them into a Paper.

The most reliable sources from which we have gained our knowledge of the plants cultivated by the Ancient Egyptians are:—Firstly.—From the plant remains which have been found in their tombs and other monumental buildings, which are now preserved in the museums of Berlin, London, Vienna, Paris, Turin, Leyden, and Florence. Secondly.—The numerous representations of plants on the monumental structures which the Ancient Egyptians used for sacred and profane purposes give us also an idea of the vegetation, although they are inferior to those of animals. Thirdly.—The writers of classical antiquity supply us with a very good description of the Flora of Ancient Egypt.

A very interesting fact has been ascertained by comparing the plant-remains of nearly 5,000 years old with living examples of the same species, that is, that no essential variation between the two is noticeable,

except only in the fruit of the pomegranate, in which a slight deviation is observable. But on comparing the ancient flora of Egypt with the modern one we find that a change regarding the distribution of several plants has taken place. Many plants at present cultivated in Egypt, not a sign of them has been traced in Ancient Egypt; and on the other hand, plants which were plentiful 5,000 years ago have disappeared from the Lower Nile territory. There is no doubt that several plants and fruits entombed found their way by commercial intercourse from other parts of the world.

The fruit trees of modern Egypt are the date, sycamore, nabok (*Zizyphus Spina-Christi*, Willd.), opuntia, orange, citron, apricot, peach, fig, mulberry, apple, pomegranate, banana, pear, plum, and grape; of all these fruits only the date, sycamore, fig, grape, and pomegranate, were known to the Ancient Egyptians. It was the happy thought of Professor Unger to disintegrate and examine the unburnt bricks of which the Pyramids of Dashur Group have been built, with the view to the discovery of the plant materials which had been used in their preparation. The bricks were immersed in hot water, the earthy part crumbled away, leaving the vegetable portion free. Amongst the organic remains detected was *Eragrostis Abyssinica* (Linn.,) or Teft, a graminaceous plant, which is cultivated for its grain up to the present day in Abyssinia. This discovery favours the assumption that *Teft* was cultivated by the Ancient Egyptians. Prof. Unger found also abundance of wheat and barley straw, grains of both the cereals, and a few capsules of the flax-plant.

Of cereals found entombed, the Berlin Museum possesses several kinds of wheat. There is some of *Triticum vulgare*, mixed with which are a few grains of barley; also *Triticum turgidum* (Linn.), the prevailing kind now in cultivation in Egypt, called Egyptian wheat, and two other kinds—*Triticum spelta* (Linn.), and *Triticum monococcum* (Linn.), neither of which is cultivated at the present time. Professor Unger ascertained the fact that from the abundance of the wheat and barley straw in the bricks of the Pyramids of Dashur these cereals must have been extensively cultivated. *Triticum vulgare antiquorum* likewise occurs in the bricks, and, strange to say the same variety was found by Professor Heer in the remains of the Lake-dwellings in Switzerland. The barley has been determined as *Hordeum hexastichon* (Linn.) It is still believed that wheat-grains taken from the Egyptian mummies have germinated; this is as good as proved to be impossible, and is probably

an intentional attempt at deception, for whenever mummy-wheat was supposed to have germinated it was undoubtedly recent grain mixed with it. The true mummy-wheat is dark brown and carbonised.

The cultivation of *flax* must have also been very extensive, and manifold were the uses made of the linen, and principally in the embalming of the dead, and for the garments of the priests, who only were allowed to wear it. In the Berlin Museum are preserved two Ancient Egyptian flax-combs; between the teeth are still some fibres attached, which by microscopical examination prove to be flax. Two kinds of flax have been determined from the entombed seeds, viz.—*Linum humile* (Mill.), and *Linum angustifolium* (Huds.). The latter plant is a perennial, a native of the Mediterranean region, and not cultivated at present. The former is still cultivated in Abyssinia, though not for the sake of its fibre and oil, but for the seed, which is used by the lower classes for food, and is generally eaten during Lent. The seed is roasted and ground, the flour is mixed with water to a paste, to which is added salt and pepper. A very interesting fact is that the seed of *Linum humile* has lately been found in the Pile-dwellings in Switzerland, and it is the opinion that the inhabitants were of African origin.

The sycamore (*Ficus sycomorus*) was one of the most abundant trees of Ancient Egypt, and is still so at this day. Religious worship was paid to this tree by the ancient Egyptians, and it was dedicated to the deities—Isis, and Nutpe. The departed soul received also under the holy sycamore tree the wreath of vind cation. A great part of the wooden objects of Egyptian antiquity in the Berlin Museum are prepared from the wood of the sycamore. Its fruits are found often entombed, and are smaller and less flavoured than those of the common fig. One of the relics of the Berlin Museum, found in a tomb, is a cake on a layer of sycamore leaves.

The extensive culture of the *olive* in Ancient Egypt had been spoken of by ancient authors, and Theophrastus mentions the appearance of the olive in the Oasis of the Desert of Libya, where the tree at the present time is growing; but hitherto the fruit has not been found in any of the tombs, the hard stone of which would have preserved well. The Berlin Museum possesses a relic made from olive branches—five small bundles, each containing three small branches, are tied together with strips of palm-leaves. Professor Lepsius, the great authority on Egyptian antiquity, believes this bundle has been used for the same purpose as the rod is used at the present time to chastise children. Many funeral-wreaths pre-

pared from olive-leaves have been found, but these belong to the period of Osarkon, 22nd and 25th dynasties; they were the symbol of vindication of the departed soul before the judgment of Osiris. There are other funeral wreaths in the possession of museums made of the leaves of *Mimusops Kummel*, embellished with flowers of *Acacia Nilotica* (Del.), but they belong to a later epoch, that of the Roman-Greek. The use of the flowers of this common Egyptian tree for wreaths has been mentioned by Theophrastus. *Chrysanthemum coronarium* (Linn.), a native of the Mediterranean, and cultivated at the present time in our gardens, is only found in Egypt growing near Alexandria, and was no doubt cultivated in the flower gardens of the Ancient Egyptians. A *Centaurea*, the species of which could not be determined, occurs. Other wreaths are decorated with the flowers of the blue lotus.

The before-mentioned *Acacia Nilotica* was the only tree of any size in Ancient Egypt producing a durable wood suitable for ship building, but this only in lengths of, at the most, nine to ten feet.

Amongst the entombed fruits are also found juniper berries, probably of *Juniperus excelsa* (Bbrst.), which kind inhabits Asia Minor, the Island Tharos, and Abyssinia; whilst the common juniper, *Juniperus Phœnicia* is a native of the Mediterranean, and does not, as is the case with all the Coniferæ, appear in Modern Egypt; therefore it is doubtful if the tree was wild or was cultivated in Ancient Egypt; and it is more admissible, that the berries of *Juniperus Phœnicia* and also the objects made from coniferous wood found their way from Syria or Asia Minor. No doubt the juniper berries were used for fumigation as at present.

The culture of the date palm in Ancient Egypt was undoubtedly as extensive as at the present time. The tree extends over the whole of North Africa and part of Asia Minor; but its real home is not known. Its fruit is found abundantly in the tombs; so also that of another palm, *Hyphœne Thebaica* (Mart.). The latter palm, which is frequently mentioned by ancient authors, is distributed over the greatest part of North Africa, and is found in Guinea. A third kind of palm fruit is that of *Hyphœne Argun* (Mart.), which at present grows in the Nubian Desert; the finding of this fruit in the tombs is the more interesting because the tree is not cultivated in Modern Egypt, nor was it, it is believed, in Ancient Egypt.

The pomegranate, *Punica granata* (Linn.), has not only been frequently found entombed, but also represented on monumental structures. The ancient fruits are smaller than the modern ones, and differ from them

in having from four to six cells instead of six to eight. One of the fruits preserved in the Berlin Museum has been bitten into, as the marks of both rows of teeth of a human being are plainly to be seen.

The castor oil tree, *Ricinus communis*, Linn., seems to have been cultivated as extensively in Ancient Egypt as it is at present in Modern Egypt, for the sake of the oil. The seeds of this tree are frequently found entombed, and have preserved a very fresh appearance, and several have been sown, but without results.

The culture of the *vine* in Ancient Egypt must have been also very extensive. On all, even the oldest, monumental structures, the vine is represented, as also branches of the same and the gathering of the grapes. The ancient authors give also an account of its culture and the consumption of the wine, while the results of the latter are represented on monuments. The berries of the vine have been frequently found in the tombs; and the Berlin Museum contains a large series of them. They are as large as fairly-sized raisins, of an oblong shape, and probably of a dark blue colour. Several berries which have been examined contained not one, but three stones. For the purpose of examination they were immersed in water for four days, and afterwards hot water was poured on them, but they did not soften, nor present the fleshy and clammy nature of softened raisins, and on being pressed crumbled like mouldy wood, though the water in which they were soaked acquired a dark chesnut-brown colour. The French chemist, Fontinelle, did not succeed in finding sugar in the berries.

No plant was more venerated than both the renowned species of *lotus* (*Nymphæa lotus*, Linn., and *N. cærulea*, Savig.) These were the favourite flowers of the country. They are represented on almost all monumental structures, and in the hieroglyphs they indicated the upper country, or Southern Egypt. And it is well known what an important part the water-lilies played in the religious ceremonies of the ancient Egyptians. From the earliest time the root and seed served for food to the inhabitants of North Africa, but in Modern Egypt they are not used for this purpose. The ancient Egyptians called the lotus *seschnin*, and with a slight alteration *bischnin* is the Arabic name of the plant. Many fragments of the lotus have been found entombed, and two well-preserved buds are in the British Museum.

Another aquatic plant related to the lotus is *Nelumbium speciosum*, Willd., which must have also been extensively cultivated in Ancient Egypt, as it is mentioned by ancient authors, and is represented on the

earliest monuments; but it has now quite disappeared from the country, and was in all probability originally introduced from Asia, of which it is a native.

One of the most important plants of the Ancient Egyptians was the *papyrus*, which, like the lotus, is seen on the oldest monuments. Fragments of the papyrus are found in nearly all the tombs. It was used for many purposes, both ornamental and useful, but principally for paper, which was of the greatest reputation in antiquity. It is worthy of note that this plant, whose culture was anciently so extensive, has now entirely disappeared from Egypt, while in Sicily and Syria, where the plant has undoubtedly been introduced from Egypt, it is perfectly naturalised. Only on the Blue and White Upper Nile is the papyrus found growing wild.

Amongst the Egyptian plant-relics in the Berlin Museum are the tuberous roots of another *Cyperus*, *C. esculentus*, Linn. This plant is still cultivated in modern Egypt; as its fleshy roots contain oil and sugar, and form a well-tasting dish.

In the Museums of Berlin, Vienna, and Florence are fruits which have been found entombed, and which have been recognised as those of *Cordia Myxa*, Linn. It is a middle-sized tree and is a native of Abyssinia, but is still here and there cultivated in the gardens of Modern Egypt. Also the fruits and leaves of another Abyssinian tree, *Mimusops Kummel*, Hochst., are represented in the Berlin collection. The fruits are of the form and colour of the hips of the dog-rose; they and the leaves have been found in some abundance in tombs. The Ancient Egyptians would seem to have used the leaves for making funeral wreaths, as such a one is in the Museum of Leyden, and the leaves of it are folded and strung on very thin strips of palm leaves. This use of the leaves renders it probable that the tree was cultivated, as it is unlikely that they reached Egypt by commercial intercourse. It is not now found in Egypt, having together with the Papyrus plant and the Nelumbium disappeared in the course of the last centuries, no doubt from the discontinuance of their culture.

Numerous seeds in the possession of the Berlin Museum have been identified as those of a watermelon, *Citrullus vulgaris*, Schrad. This discovery is of the greatest importance, as it is now settled that the watermelon is a native of Africa. Not only on the Upper Nile, but also in other parts of West and South Africa has this species been found growing wild. The fruits are much smaller and less juicy than the

cultivated ones; but it is said that after a short culture the wild ones attain to the same perfection. It is, therefore, no longer doubted that the watermelon was first cultivated in Egypt, and spread from thence to Asia Minor, and later to South Russia and Hungary. The watermelon is mentioned in the complaint of the Children of Israel—"We remember the fish which we did eat in Egypt freely; the cucumbers, and the *melons*, and the leeks, and the onions, and the garlick." (Numbers xi., 5.)

The predilection of the Ancient Egyptians for the onion tribe is not alone established from the above Scripture passage, but also from the numerous representations of it on the ancient monuments. We also learn from Herodotus that the labourers employed building the Pyramid of Cheops ate onions, leeks, and garlick to the value of 1,600 silver talents (about £849,600). The Modern Egyptians follow the example of their ancestors, as onions are extensively cultivated by them, even in the oasis of the Lybian Desert, and garlic not less so in the Valley of the Nile.

There is another fruit found in the tombs, of which the Berlin Museum possesses a number of seeds. It has been determined to be *Balanites Ægyptiaca*, a small tree found in North-tropical Africa, extending from Senegal to Abyssinia. Single specimen trees are found in the gardens of Modern Egypt, but in ancient times it must have been largely cultivated, as the seeds are commonly found entombed.

Other fruits in the Museum of Berlin have been identified as *Sapindus emarginatus*, Vahl. The tree is a native of East India, where its fruits are used as soap, both for cleaning the person and for washing fine linen. In Sanskrit they are called *phenilla*, which means froth. It is not improbable that the Ancient Egyptians, whose commercial intercourse with East India is not doubted, received the fruits from thence just as their descendants do to this day for the same purposes from the East.

The discovery of branches of the poisonous shrub, *Calotropis procera*, R. Br., a native of Persia, is the more interesting as it has been ascertained that the branches still contain the intense bitter natural to the plant, and has proved that the bitter principle in plants is more lasting than that of sugar.

ON THE DECREASE OF MANY SPECIES OF INSECTS AND INCREASE OF SOME IN SOUTH AUSTRALIA.

By Otto Tepper, Corr. Member.

(Read February 5, 1878.)

Long-continued observations of the life and habits of insects in general have produced the impression on me that, at least in the localities I visited frequently in the course of my rambles, the number and variety of many insect tribes were rapidly decreasing from year to year, while some of them apparently maintained their position, and a few materially increased in number. Many species of Coleoptera, as Longicornia, Buprestidæ, Lytta, &c., some butterflies, &c., have become scarce, while some even seem to have died out altogether in some localities; notably those seem to be first and most frequently affected whose conditions of life depend upon certain assemblages of trees and shrubs. This appears not to be altogether due to the actual want of such trees and shrubs, for I have seen and examined carefully patches of blooming mallee and myrtle, many acres in extent, several times a week for months, but only met with a few of the commonest beetles, flies, or wasps, though at other places not far distant, and almost exactly similar, a great many of the desired Coleoptera, &c., were taken upon these their favourite flowers. Far less direct influences seem to furnish the main cause of this comparative barrenness, the chief of which, I am disposed to consider, is the browsing of cattle, sheep, &c. The woodcutter's axe and the farmer's plough coming next in order. All these change the aspect of nature greatly, and alter very much the relations of vegetable and animal life.

For illustration I will select Monarto on account of various reasons. It is situated about seven miles east of Callington, and was, at the time of my stay, a newly-formed farming settlement on the eastern slope of a

range of hills facing towards the Murray and the Murray scrub. The hills mentioned, formed of metamorphic rocks and granite, were timbered by various species of Eucalypts—whitegum, mallee (*E. dumosa*), peppermint, casuarina, myrtaceæ, and proteaceæ in a number of species, besides other trees and shrubs of minor importance, of which the so-called box-tree and melaleuca were the principal.

Towards the river, and within a mile and a half from my cottage, a black sea of mallee met the view, interspersed with groves of pines (*Frenela*) and patches of porcupine grass; here and there varied again by hakeas, banksias, &c., in smaller patches. A low granite range divided this region (about 12 or 15 miles from east to west) into two unequal parts, which I frequently scoured in all directions during the most favourable part of the year, viz., from September to April, for the purpose of collecting insects. In a period of some eighteen months, comprising a season and a-half, I obtained between 400 and 500 species of coleoptera, distinct from some 500 species I had previously collected.

Some parts of this locality were densely wooded, some open; large clearings had been made in others for farming and other purposes—hill-sides alternating with plains, sand patches with rock; thus presenting a very favourable field for insect development. Yet one could pass for miles through these sceneries and hardly meet any but solitary insects belonging to the commonest species, and examine dozens of mallee, myrtle, or melaleuca bushes, steeped in a cloud of bloom, with the same result. Suddenly, one would come across a patch, limited in extent, teeming with life in great numbers of individuals and species. Yet not one quality could be specified not possessed by others, almost deficient of life, to account for the difference and the predilections of the insects. Another circumstance worthy of remark is this, that these favoured spots are not permanent, but seem to be subject to change in an arbitrary manner, which I often heard mentioned by other collectors.

What is the cause of all this?

My observations, limited as they are, point to this answer, viz., that the desertion of one place and the acceptation of another is mainly due to the disturbances the insects suffer while depositing their ova, amounting often to total prevention. These disturbances are caused by the browsing of cattle and sheep, not to mention, for the present, the radical agencies of axe and plough. Even if the ova be successfully hatched, an invasion of the feeding-ground of the young larvæ by the same intruders prevents many of them from attaining to maturity, either by

being crushed or shaken off the plants, and falling a prey to ants, &c. The consequence is that insect life can only develope freely at such spots which accidentally escape invasion. Another well-known fact greatly assists in localizing species, namely, that most females of many species do not quit their own birthplace voluntarily, for as soon as impregnation has taken place they deposit their ova at the next suitable plant or other place and die. No great wonder, therefore, localities of exuberant insect life should remain isolated. Now, the chances are greatly against the escape of such localities from invasion for any length of time wherever cattle are depastured ; thus, instead of extending, which is a slow process at most times, they gradually contract, and at last become extinct, perhaps in one season, and their inhabitants exterminated.

New centres may be formed, and are, as frequently observed, through individuals, carried accidentally by instinct, gusts of wind, &c., to other favourable spots of bush; but, again, the chances are much against the preservation of the same ratio of species, especially where overstocking is such a prevailing evil as here, and the tendencies in settled districts are always towards extermination.

This result would be rather beneficial to man than otherwise if nature acted discriminatingly, which is not the case, extermination befalling the innocuous and the useful almost always in the first instance, the others apparently receiving an impetus in the opposite direction, completing the work of destruction, initiated by man unwittingly, in an increasing ratio.

Insects, as well as animals, being either herbaceous or predatory, the former draw their sustenance from vegetation direct, while the existence of the latter depends upon the first, limiting their increase within narrow bounds, fluctuating little in a normal state of nature. The great majority of predatory insects (ants, spiders, parasites, and pseudo-parasites excepted) produce a much smaller number of ova than the vegetable feeders, and are therefore more exposed to reduction in number and final extermination by inimical causes than their prey the vegetable feeders. These, in their turn, are, in general, gifted with a prodigious fecundity.

Now, if one or more species of the predatory insects be extinguished, or only greatly reduced in number, the check upon the herbaceous insects, or upon some of them, is removed, and they at once avail themselves of the opportunity, and appear in augmented numbers, sometimes inconceivably large, ending, after total destruction of their food-plant, by

starvation, or through unfavourable physical causes. As examples, I beg leave to mention Locustidæ, the Colorado beetle, some Melolonthidæ (to one species of which is owing the destruction of thousands of Eucalypti in Monarto), several species of moths, &c. The undue increase of their number could, I firmly believe, be proved to be due to the removal of the check upon it, be it in the form of some predaceous beetle, as most likely; of some birds, of climate, or condition of soil. In any of these *man* may, nay, often *is*, the foremost motor.

Insect species in general are best off in localities with alternations of wooded and open tracts; there the soil preserves its humidity for the longest time, because, on the one hand, the water descending as rain is greatly retained, and can percolate freely in the ground at the same time that the decay of dead vegetation is promoted; on the other hand, the ground being shaded remains always tolerably cool, conditions favourable to predatory insects — Carabidæ, &c. The combined effect is to promote from year to year a more luxurious growth of vegetation, well able to withstand the attacks of destructive insects, and sheltering their enemies—predatory insects, birds, &c. In localities where some plant-eating insect increased inordinately, mostly a great deficiency of predatory insects and birds may be noticed. Where there are many woody tracts at small distances surface springs abound, reacting favourably upon the former, thus improving and conserving the favourable aspect of the place.

Now man enters upon the scene.

The arable portions are carefully grubbed, cleared, and ploughed, and on the rest he depastures his cattle and sheep. The summer's heat parches the soil; scores of insects, lizards, birds, &c., perish; those birds feeding upon the former, their eggs or larvæ, which have not been wantonly shot, withdraw themselves to other regions offering more privacy, or die unable to bring up their young to maturity. Useless weeds and destructive insects, gifted with great fecundity and adaptability, augment apace for a while. The winter's rain descends unchecked, and carries the loose unprotected surface-soil annually in millions of tons to the sea. The shrubs and grasses continually browsed off, and unable to seed properly, wither and die. The trees thinned by the wood-cutter, in whose shade formerly scores of humbler or younger members flourished, and in return insuring for their big brother plenty of moisture and coolness, sicken, are attacked defencelessly by some insect, and succumb. Surface springs dry up gradually, elsewhere retentive strata get disturbed, the rain water per-

colates, and is carried far away ere it reappears, leading unthinking people to fancy that grain cultivation will augment the number of springs.

Protection of trees and shrubs and speedy replanting, where extinct, are the only preventative remedies. Every rocky hillock, every sand-patch, every roadside, ought to be studded with groves and avenues of trees and shrubs, and the cattle carefully excluded from them, for the nipping off of the young shoots means dwarfing, sickening, and often death for many of them. When this is brought about, there will again greet our ear the joyous hum of the beetles, the stealthy hush of the lacertilia, and the merry twitter and song of the birds, but in well-balanced number, their mutual checks being carefully supplied by nature. Only in deserts and deserted places locusts hatch in overwhelming numbers, and deserts are places without sufficient vegetation.

The chief beetles which have, according to my observations, shown a decrease in numbers, are the following:—

Most Buprestidæ, especially *Stigmodera*, many *Elaterini*, *Rhynchophora* (weevils), *Cetonia*, *Lamprima*, *Passalidæ*, *Lyttæ*, some species of *Clerus* (*C. notosus*, *trichodes*), *Amarygmus*, *Helops*, and other *Tenebrionidæ*; and most species of *Carabini*, and *Staphylini*.

As stationary or increasing in individuals I have noted—Among Buprestids a blue and yellow banded *Stigmodera*, resembling *S. Yarellæ*, which is very variable in size and colouring; also some of the genus *Cesseis*: two or three species of *Elater*, many weevils, notably the beautiful diamond weevil; the common black *Cetonia*; most *Melolonthidæ*, *Rutelidæ*, and almost all the *Copridæ*: many *Chrysomelidæ* and *Chryptocephalidæ*: of *Carabini*, *Calosoma*, *Bembidium*, and *Phylophlaus* appear little affected, and the red-headed *Staphilinus* seemingly increases.

ON THE HABITS AND DESCRIPTION OF A DESTRUCTIVE BEETLE.—(*MELOLONTHA DESTRUCTOR*).

By Otto Tepper, Corr. Member.

(Read June 18, 1878).

Some years ago I resided for about eighteen months in the district of Monarto, about eight miles east of Callington and the River Bremer, arriving there shortly after Christmas, 1871. The peculiar appearance of nearly all the larger Eucalypts struck me at once as something remarkable, not having observed anything like it before. The branches of these Eucalypts—(*E. Viminalis (?)* and *E. Odorata*)—did not carry their leafy crown at the extremity as usual, but axillary, a great number of their twigs having sprouted along three sides of the limbs, exhibited the only green upon the greater number. They presented an appearance as if artificially surrounded with wreaths, when viewed from a distance. A few of the younger and more vigorous individuals still preserved the normal *habitus* entire, while some had a few branches affected as described above.

This state of unhealthiness, for such it was evidently, did not extend to such parts where the undergrowth had been left comparatively undisturbed, but only to the cleared portions and the borders thereof. At that time the farmers had occupied the place for about four years, and everything still looked rather primitive. Making inquiries, I was told that a beetle committed these depredations. This information I regarded rather dubiously for some time, finding so very few live specimens, and still less remains of dead ones. On some previous occasions I had seen Eucalypti stripped of their leaves, but had found the *larvæ* of divers moths and Chrysomelidæ to be the perpetrators. Great as was the damage done by the latter, yet it was in no proportion to what I had now before me. What immense numbers of this beetle must there be at

work to consume such quantities of leaves! What became of them since? Where do they pass their caterpillar existence?

To answer such questions as these I could do nothing at the time but wait for their reappearance.

In the succeeding month of September a few began to show themselves, coming out of the ground after sunset. Some time previously I had noticed in the looser parts of the soil a great number of caterpillars, of the characteristic *Melolontha* habitus, and of all sizes, little distinguished either in form, colour, &c., from others of its genus, their skin being a little tougher in texture, and of a more yellowish colour than that of most others. The size of the full-grown larvæ is about 1½ in. in length and ½ in. in diameter. After several unsuccessful attempts, I found at last some chrysalids in the ground at a depth of from 9 to 12 in., in different stages of development, and also one or two beetles, which had been too weak to pierce the soil, and died after their transformation, thus proving identity.

The chrysalis lies in an oval hollow at the depth mentioned above, the lining of which is formed by the skin of the larva.

In the succeeding months of October and November ample opportunities offered to study the voracious habits of the species, for which I propose the appellation "*Melolontha destructor*."

During the day few could be seen, and none at all active, but soon after sunset countless myriads made their appearance. Like swarms of bees they encircled the treetops in such numbers that the hum of their wings was distinctly audible at a distance of a hundred yards in the calm of an evening, and the working of their mandibles clearly discernible at the base of trees up to 40 feet high, whose leaves they were engaged in stripping off. This will give an idea as to their number.

At about 10 or 11 p.m. the crowds began to diminish, and I cannot remember having noticed them after midnight in cool weather, but during warm and sultry nights a few continued in action till shortly before sunrise. In early dawn, or in the moonlight, the trees attacked by them seemed to be surrounded by a light cloud of vapour like a veil, when seen from a distance, arising from the numerous Melolontha flying around them. The trees were not attacked simultaneously, but in succession; those already sickly from previous attacks, or other causes, obtaining the preference before the more vigorous, the healthiest escaping sometimes altogether, sometimes with only a branch or two stripped bare. A few night's feasting left the victims bare of leaves, and the

ravagers removed to others. Yet (considering the number of coleoptera, an astonishing fact) here and there one or other remained almost intact in the midst of destruction.

In the daytime, the beetles, after dispersing, bury themselves in the loose soil, as deep as its nature will permit, and I often succeeded in exhuming them from depths varying from three to twelve inches, even at a much later part of the season. During rainy weather I have not noticed them at all in action; the moisture probably making their wings unfit for flight. They do not fly very fast; in straight lines or large curves and for considerable distances. Those that fall to the ground in an exhausted state are eagerly attacked and devoured by the ants, those that survive finally die, as far as I could ascertain, in their self-made grave. The females lay their eggs in the soil adjoining the roots of trees and under logs, from whence the larvæ disperse, living on decaying vegetable mould apparently.

How far the ravages of this beetle extended laterally, I was not able to ascertain, but observed them personally over a considerable area, containing many square miles.

The principal causes for their inordinate increase since the settlement was formed appear to be : (1) the loosening of the soil, and (2) the injudicious persecution and destruction of predatory animals.

The former is of great advantage for their preservation, inasmuch as it allows them to bury themselves easier and quicker, thus increasing their immunity from attack by almost any enemy. Before broken up the nature of the soil was not favourable, as, being deficient in lime, it dried hard in summer, presenting great obstacles to the larva as well as the perfect insect, to ensure safety by rapid burrowing.

The destruction of predatory insects (large Carabidæ, etc., strong enough to cope with them successfully) aids their increase, but reptiles and birds, lizards, owls, hawks, etc., may have a still more direct influence by diminishing their enemies. The lizards and hawks are in most parts relentlessly extirpated by the settlers, because the former are universally considered as venomous, and the latter are killed, either for occasionally appropriating a chicken or two; from superstition; or from ignorant love of killing. The small loss in the poultry-yard is instantly observed; but the great benefit rendered by them as destroyers of insect pests is little known and less acknowledged.

In the localities where the destructive Melolontha buzzed about in clouds at night few of the larger predatory beetles existed, and few birds

of prey except in the less disturbed parts of the forest where the latter were more plentiful, and few signs of the former perceptible.

MELOLONTHA DESTRUCTOR (New Species.)—General form and habitus appertaining to genus; female slightly larger than male; length, three-quarters of an inch; diameter, one quarter of an inch; prevailing colour of upper part, bright chestnut brown; head of the female and labrum of male much darker, almost dull black; neutral parts of both sexes a uniform dark brown; eyes small, black; labrum distinct, much developed, edge turned up, well adapted for burrowing; maxillæ slender; mandibles short, strong, toothed; antennæ in both sexes with seven points and three lamellæ, latter narrow, straw colour with female, brown with male; prothorax well arched; flanges toothed and upturned; scutellum medium-sized; elytra translucent, arched, reaching well down the flanks, but leaving the last abdominal segment nearly uncovered (a little shorter with the male), marked by five longitudinal seams, edges strong (inner one black), the whole dotted over with paintlike minute depressions, arranged diagonally; wings large; flight sustained and accompanied by a loud humming noise: first and third pair of legs strong, thorny appendages, well adapted for grasping and burrowing; abdomen large, soft; the third from last segment the largest; last segment small, triangular, under surface of thorax covered with long tawny hairs; shorter ones lining the upper interior edge of prothorax, outer edge of elytra, and first joints of antennæ; feeding from point of leaves towards stalk, moving backwards and eating mostly in regular curves.

INFANTILE MORTALITY IN SOUTH AUSTRALIA.

By Henry Heylyn Hayter, Cor. Member, F.S.S., &c., &c.,
Government Statist of Victoria.

[Read March 19, 1878.]

As I fear it may be thought presumptuous for one who not only has never resided in South Australia, but has not even set foot within her limits, to address the Adelaide Philosophical Society on a subject affecting the colony, it is not without considerable diffidence that I venture to do so. Considering, however, that my official position affords me peculiar facilities for obtaining information respecting each colony, and for collating and comparing it afterwards, I trust I shall be excused for bringing forward a matter which is undoubtedly one of the most vital importance.

South Australia, although less populous than Victoria, New South Wales, or New Zealand, is in many respects in advance of those colonies or of any other colony of the Australasian group. A greater equality exists between the numbers of males and females; a larger, and, per head, a much larger, extent of land is under cultivation; a larger quantity of wheat is raised; the taxation is lighter*; the exports per head are greater than in any other Australasian colony; and when it is added that whilst the marriage and birth rates in several of the colonies are notably decreasing, those in South Australia have for years past been steadily increasing, and in 1876 were, the former in excess of the rate in any other colony of the group, and the latter in excess of that in any other colony except New Zealand. It will, I believe, be readily admitted that South Australia is in pos-

* This statement is true over a series of years, but in 1876, for the first time, the taxation per head was slightly lower in New South Wales than in South Australia.—Author.

session of certain material advantages the contemplation of which may well afford thankfulness and satisfaction to the minds of her colonists.

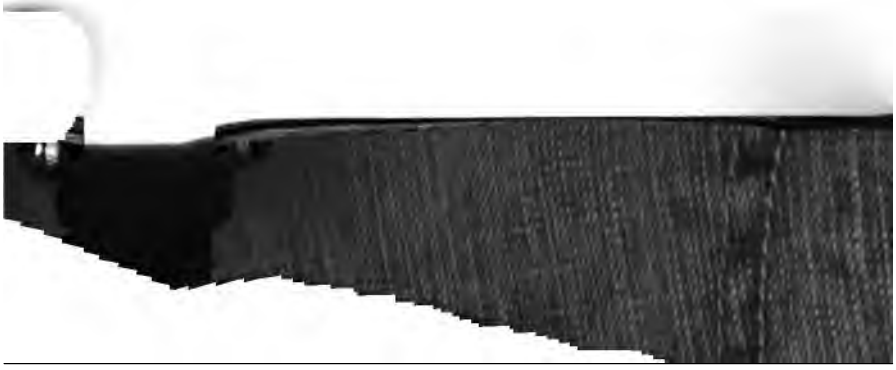
But there is one point in respect to which South Australia suffers in comparison with every other Australasian colony. I refer to the excessive mortality of her infants.

This point came prominently under my observation whilst compiling the "Victorian Year-Book, 1876-7." A table showing the infantile mortality of each colony over a series of years, based upon the principle of comparing the deaths of children under one year of age with the births, was given at page 68 of that work. For my present purpose, and in order to make the calculations more readily understood, I have slightly altered this table so as to show the proportion of deaths of infants to every 1,000 births instead of every 100, and thus have been able to obviate the necessity of using decimals.

A reference to the first of the appended tables (A.) will show that during the ten years ended with 1875, 157 children in every 1,000 born South Australia died before completing their first year, whereas the proportion was 126 in Victoria, 125 in Queensland, 104 in New South Wales, 102 in New Zealand, and only 101 in Tasmania. The infantile mortality of South Australia was thus 25 per cent. above that of Victoria, 26 per cent. above that of Queensland, 51 per cent. above that of New South Wales, 54 per cent. above that of New Zealand, and 55 per cent. above that of Tasmania.

Also in each of the respective years of the decenniad it will be noticed that the proportion was always higher in South Australia than in any other colony, and even at periods when circumstances caused the infantile mortality to be exceptionally high in one or more of the other colonies, it so happened that it was always higher in South Australia. Thus in 1866, when infants died in Queensland in the proportion of 167, and in Victoria in that of 153 per 1,000 births, they died in South Australia in the proportion of 174 per 1,000 births. In 1867, when they died in New South Wales in the ratio of 124 per 1,000 births, they died in South Australia in the ratio of 178 per 1,000 births. In 1875, when they died in Tasmania in the ratio of 131, and in New Zealand in that of 126 per 1,000 births, they died in South Australia in the ratio of 181 per 1,000 births.

The average annual infantile death rate of South Australia (157 per 1,000 births) was never reached in any of the other colonies except



Queensland, even during the very worst years of the decenniad, and in Queensland it was only reached in one year, namely, 1866.

The year in which the rate of infantile mortality was lowest in South Australia was 1869, and even in this 131 infants out of every 1,000 born died within the year. This proportion was never approached in New South Wales or New Zealand, even in the very worst years; it was reached only once in Tasmania, twice in Queensland, and three times in Victoria.

In all the years of the decenniad the infantile death rate was higher in South Australia than in New South Wales or New Zealand during their worst years; in nine of the years it was higher than in Tasmania during its worst year, in five of the years it was higher than in Victoria during its worst year, and in four of the years it was higher than in Queensland during its worst year.

Turning to older countries, it will be found that the death rate of infants in England and Wales during ten years was 154 per 1,000 births, which, although higher than that in every other Australasian colony, was 2 per 1,000 below that of South Australia. Also, that in Scotland the mean death rate of infants over a series of years was 126 per 1,000 births, which, being exactly equal to that of Victoria, was very much below that of South Australia; and further, that the mean death rate of infants in London, namely, 161 per 1,000 births, with the exception of once in Queensland, was never approached in any colony of the group except South Australia, in which it was exceeded in four and equalled in one of the years of the decenniad to which the table relates.

The registration of deaths, as it must in all cases precede burial, is probably effected with equal and almost perfect accuracy in all the countries and colonies named, but it is possible that an appearance of excessive infantile mortality might arise from the registration of births being more defective in one country than another. According to the returns there is no reason to suppose this to be the case in South Australia, as the mean birth rate there, based upon the registrations, is found to be higher than that of England, Scotland, Victoria, or Tasmania, to approximate closely to that of New South Wales, and, over a series of years to have been only exceeded to any extent by that of Queensland and New Zealand; whilst during the past year (1876), as has been already stated, the birth rate of South Australia was exceeded by that of the colony of New Zealand only. (See Table B.)

There is thus no ground for believing that the high death rate of

infants shown by the registration returns of South Australia does not really exist or is at all exaggerated. To trace the various agencies by which such a calamitous result is brought about would be to any one a difficult task, and would manifestly be impossible to one unacquainted with, and who has no means of gaining an intimate knowledge of, the ramifications of social life in South Australia.

Whether it be due to defective sanitary arrangements, or to neglect resulting from the debility, indolence, or intemperance of mothers, or from the fact that custom, inclination, or the necessity of their position, causes many of them to engage in some trade or business; or to the ignorance of mothers as to the best mode of rearing children, resulting, perhaps, from early marriages, or to the administration of aperients to new-born infants—butter, sugar, and such other abominations; or to the administration of spirits, cordials, soothing powders, or other narcotic drugs; or to weaning at too early an age; or to administering innutritious food, or food of too substantial a consistency, or too farinaceous a character, either before or after weaning; or to the attendance on the mother of midwives; or to baby farming; or to the poverty of the parents; or whether, on the other hand, it be mainly due to congenital weakness or to the effects of the climate, which, although probably not so hot as that of New South Wales, is hotter than that of Victoria, and, according to the observations of Sir G. S. Kingston, is drier than that of either Victoria or New South Wales, these are matters on which I am unable to pronounce an opinion, but which, I submit, demand the fullest and most careful investigation.

To aid in such an enquiry I have prepared Table C, which shows the causes of death of infants during the three years ended with 1875, arranged in the order of their fatality. I regret that I have been unable to obtain the material for compiling the information over the whole period of ten years to which Table A relates. Although I cannot learn that it has ever been published for the first seven years of the decenniad, it probably exists in the office of the Registrar-General of Births and Deaths in South Australia, and if so, could doubtless be procured without any difficulty.

It is also desirable that the ages at which the infants die should, if possible, be ascertained, so that it might be known in what proportion of instances the death takes place, soon after birth, or after the expiry of one, three, or six months, &c. This information is not now to be found in the published returns.

According to Table C not more than half the deaths are set down to specific diseases, and no less than 1,708 out of 3,641 are returned as having resulted from atrophy, debility, convulsions, premature birth, and teething. These terms are in the highest degree indefinite, being either names of symptoms of diseases, not of diseases themselves, or circumstances entered as supplying convenient expressions for assigning a cause of death when the nature of the actual complaint is not known; 588 more of the deaths are set down to diarrhœa and dysentery, an enormous proportion. Did not a large number of these deaths result from improper food and treatment, and could not many of them have been averted by proper expedients?

The occurrence of whooping-cough, measles, and scarlatina, in epidemic form, will be readily observed by the increased mortality from those complaints respectively in the first, second, and third year referred to in the table. The increased number of deaths from diarrhœa, always found to be concurrent with a measles epidemic, will also be noticed in the middle year.

There is happily no ground for supposing that infanticide exists to any appreciable extent in South Australia, not one of the deaths during the three years under notice having been set down to that cause; 10 deaths were set down to suffocation, most probably by overlying, which is not an excessive proportion, and certainly not large enough to raise a suspicion that the deaths were caused intentionally. Accidents, exclusive of suffocation, resulted in 19 deaths, or about 1 in 192 from all causes; and privation and want of breast milk, in 78 deaths, or 1 in 47; neither of which are high proportions.

My duty is, I believe, accomplished in bringing this matter to the notice of the members of the principal scientific Society in South Australia. It is for them to consider whether any action can be suggested which may result in wiping out altogether, or, at any rate, in reducing to the utmost degree of faintness the one dark shadow which at present partially obscures the brightness which should spread over the whole of the fair surface of their promising and interesting colony.

TABLE A.—INFANTILE MORTALITY IN AUSTRALASIAN COLONIES.

(BIRTHS AND DEATHS AT UNDER ONE YEAR OF AGE, WITH PROPORTION OF THE LATTER TO THE FORMER.)

Year.	Births.	Deaths under 1 Year of Age.		Births.	Deaths under 1 Year of Age.		Births.	Deaths under 1 Year of Age.	
		Total Number.	Number to 1000 births		Total Number.	Number to 1000 births		Total Number.	Number to 1000 Births
		South Australia.			Victoria.			New South Wales.	
1866	6,782	1,178	174	25,010	3,888	153	16,950	1,939	114
1867	7,041	1,254	178	25,608	3,534	138	18,317	2,269	124
1868	7,247	1,084	150	27,243	3,054	112	18,485	1,791	97
1869	6,976	911	131	26,040	3,284	126	19,243	1,858	97
1870	7,021	1,031	147	27,151	3,203	118	19,648	1,867	95
1871	7,082	961	136	27,382	3,114	114	20,143	1,812	90
1872	7,105	1,145	161	27,361	3,334	122	20,250	2,116	105
1873	7,107	990	139	28,100	3,181	113	21,444	1,985	93
1874	7,696	1,319	171	26,800	3,341	125	22,178	2,428	110
1875	7,408	1,343	181	26,720	3,311	143	22,528	2,695	120
Sums and Means	71,465	11,216	157	267,415	33,694	126	199,186	20,760	104

TABLE A. (CONTINUED.)—INFANTILE MORTALITY IN AUSTRALASIAN COLONIES.

(BIRTHS AND DEATHS AT UNDER ONE YEAR OF AGE, WITH PROPORTION OF THE LATTER TO THE FORMER).

Year.	Births.	Deaths under 1 Year of Age.		Births.	Deaths under 1 Year of Age.		Births.	Deaths under 1 Year of Age.	
		Total Number.	Number to 1000 Births		Total Number	Number to 1000 Births		Total Number.	Number to 1000 Births.
		QUEENSLAND.			TASMANIA.			NEW ZEALAND.	
1866	4,127	690	167	2,805	264	94	8,466	849	100
1867	4,476	578	129	2,971	267	90	8,918	873	98
1868	4,460	552	124	2,990	351	117	9,391	899	96
1869	4,654	528	114	2,859	291	102	9,718	957	99
1870	4,905	526	107	3,054	298	98	10,277	956	93
1871	5,205	516	99	3,053	260	85	10,592	882	83
1872	5,265	578	110	3,010	306	102	10,795	1,074	100
1873	5,720	701	123	3,048	266	87	11,222	1,213	108
1874	6,383	776	122	3,097	321	104	12,844	1,394	109
1875	6,706	1,025	153	3,105	407	131	14,438	1,816	126
Sums and Means	51,901	6,470	125	29,992	3,031	101	106,661	10,913	102

TABLE B.—MEAN BIRTH RATE IN AUSTRALASIAN COLONIES AND GREAT BRITAIN (Proportion of Births per 10,000 persons living)

Name of Country.	Number of Births per 10,000 Persons living.	
	Over a Series of Years.	During 1876.
South Australia	392	377·1
Victoria.....	373	332·3
New South Wales	397	376·9
Queensland	422	374·8
Tasmania	299	301·1
New Zealand	409	417·3
England and Wales	349	—
Scotland	346	—

TABLE C. — CAUSES OF DEATH OF INFANTS IN SOUTH AUSTRALIA, 1873 to 1875.
(ARRANGED IN ORDER OF FATALITY.)

Order of Fatality	Causes of Death.	Number of Deaths of Infants Under 1 year of age.			
		Total in 3 years.	1873	1874	1875
1	Atrophy and Debility ...	877	256	302	319
2	Convulsions ...	454	125	148	181
3	Diarrhœa ...	423	103	165	155
4	Bronchitis ...	220	64	67	89
5	Premature Birth ...	190	53	58	79
6	Teething ...	187	54	61	72
7	Dysentery ...	165	53	60	52
8	Diseases of Nervous System, exclusive of Convulsions ...	132	23	60	49
9	Measles ...	128	1	100	27
10	Privation, want of Breastmilk	78	17	25	36
11	Gastritis and Enteritis ...	73	20	30	23
12	Diseases of Digestive Organs, exclusive of Gastritis and Enteritis ...	72	21	28	23
13	Tabes Mesenterica ...	70	16	33	21
14	Scarlatina ...	69	2	9	58
15	Pneumonia ...	60	21	13	26
16	Hydrocephalus ...	53	17	25	11
17	Diseases of Respiratory Organs exclusive of Bronchitis and Pneumonia ...	52	22	9	21
18	Thrush ...	43	14	16	13
19	Croup ...	38	10	15	13

TABLE C—(CONTINUED).

Order of Fatality	Causes of Death.	Number of Deaths of Infants under one year of age.			
		Total in 3 years.	1873	1874	1875
20	Whooping Cough ...	34	28	5	1
21	Malformations ...	32	10	11	11
22	Diphtheria ...	30	4	16	10
23	Accidents, Negligence, exclusive of Suffocation ...	19	9	7	3
	Diathetic Diseases, exclusive of Thrush ...	19	6	7	6
24	Heart Disease ...	17	3	6	8
25	Remittent Fever ...	14	4	5	5
26	Diseases of Integumentary System ...	13	8	1	4
	Erysipelas ...	13	3	4	6
27	Typhoid Fever ...	11	4	4	3
28	Suffocation ...	10	4	4	2
29	Influenza ...	9	2	1	6
30	Cholera ...	8	1	4	3
	Phthisis ...	8	3	4	1
31	Scrofula ...	6	2	2	2
32	Venereal Diseases ...	5	3	1	1
33	Diseases of Urinary Organs ...	3	2	—	1
	Quinsy ...	3	—	3	—
34	Miasmatic Diseases not classed	2	1	—	1
35	Joint Disease, &c. ...	1	—	1	—
	Deaths from specified causes	3,641	989	1,310	1,342
	Deaths from unspecified causes	11	1	9	1
	Deaths from all causes ...	3,652	990	1,319	1,343

ADDENDUM.

Since writing my paper on "Infantile Mortality" the statistics of two later years—namely, 1876 and 1877—have come to hand from the different Australasian colonies, and a table embodying the results is appended hereto.

By comparing the figures in this table with those in Table A it will be observed that the infantile death-rate of South Australia during the two years ended with 1877, although not so low as in some of the years of the previous decenniad—namely, the three years ended with 1871 and the year 1873—was lower than an average extending over the whole decennial period.

It will further be remarked that in 1877, for the first time during the twelve years over which the observations extend, another Australasian colony had a higher infantile death-rate than South Australia. This colony was Queensland, in which, during that year, 148 infants died per 1,000 births as against 140 per 1,000 births in South Australia.

INFANTILE MORTALITY IN AUSTRALASIAN COLONIES.

(TABLE SUPPLEMENTARY TO TABLE A.)

BIRTHS AND DEATHS AT UNDER 1 YEAR OF AGE, WITH PROPORTION OF THE LATTER TO THE FORMER, 1876 AND 1877.

Year.	Births.	Deaths at under 1 Year of age.		Births.	Deaths at under 1 Year of age.	
		Total Number.	No. to 1000 Births.		Total Number.	No. to 1000 Births.
	South Australia.			Victoria.		
1876	8,224	1,223	149	26,769	2,980	111
1877	8,640	1,212	140	26,010	3,299	127
Sums and Means	16,864	2,440	145	52,779	6,279	119
	New South Wales.			Queensland.		
1876	23,296	2,629	113	6,903	994	144
1877	23,851	2,785	117	7,169	1,058	148
Sums and Means	47,149	5,414	115	14,072	2,052	146
	Tasmania.			New Zealand.		
1876	3,149	286	91	16,168	1,673	103
1877	3,211	365	114	16,856	1,527	91
Sums and Means	6,360	651	102	33,024	3,200	97

ON THE ORIGIN OF MINERAL VEINS, WITH SPECIAL REFERENCE TO THE BAROSSA DISTRICT, SOUTH AUSTRALIA.

By Gavin Scoular, Corresponding Member.

[Read March 19, 1878.]

ABSTRACT.

The author commenced by enquiring into the primary condition of our planet, citing the opinions of the ancients and Laplace's nebulous theory of the earth's origin. He then sought to prove that the sources of our present accessible metallic deposits have never at any period of the earth's history been deep-seated. Treating of the metalliferous rocks of the Barossa District, he writes—"In the absence of fossil remains or a much stricter investigation of lithological identity than has heretofore been prosecuted, it would be mere waste of words were I to attempt to state unreservedly to what particular formation the rocks constituting the Barossa Range belong. The slender evidence upon which the Rev. J. E. Tenison Woods identifies them with the Silurian is not sufficiently conclusive. And though twelve years have past since the publication of the "Geol. Observ. in S. Australia," the rocks in question are still "unresolved." Mr. Selwyn, in his geological sketch of his tour in South Australia, states that "it is impossible in the absence of fossil remains to determine to what series the rocks belong; they may be of Silurian or Devonian age." Regarding their physical and lithological features the author writes, "They have undergone in many parts a considerable amount of metamorphism, and now repose at high angles of inclination. The rocks for a considerable distance both to the east and west of the junction of Victoria Creek and the South Para River have nearly all an easterly dip ranging from 50° to 60°, and in some

instances to 90°. Accordingly every 30,000 feet of strata in thickness now represents a ground surface of about one statute mile." The author failed to observe any unconformity in the superposition of the strata for a distance of from two to three miles in the channel of the South Para in the locality named, but describes the phenomenon of inversion as exhibited by a band of highly metamorphosed sandstone about one mile to the east from the junction of the Para and the Tenefete Creek. "To the east of the axis of inversion as you ascend the bed of the river, you will pass over bands of comparatively unaltered clay slate, micaceous and gneissic schists, intercalated with quartz reefs and bands of quartzites for several miles in succession, over the existing surface, and still the easterly dip of about 60° and conformity of bedding prevail. The reason for this general precision of easterly dip throughout the western slope of the Barossa Hills is stated to be, because that range is merely the eastern buttress and spring of a once stupendous arch of strata, which in times long since past extended far to the west in a grand anticlinal curve."

The author next discusses the effect of pressure and nuclear heat in the production of fissures; and combats the opinion that they are caused by earthquakes; and proceeds to describe the various methods by which it is conceived that fissures once existing in the rocks, as empty chasms, have been subsequently filled in with quartz and other vein stuffs; and endeavours to show that the vein deposits are due to hydrothermal action. In connection with the latter branch of the subject, he seeks to confirm Mr. Selwyn's opinion that alluvial nuggets of gold were products of comparatively recent infiltrations through the detrital accumulations in which they are found. He writes :—"I have in my possession a nugget taken from the alluvial workings in Hamlin's Gully, Barossa, which shows strong indications of its formation having taken place in the mould from which it was taken. It weight is about 69 grains, it measures about one inch in length, by about five-sixteenths at the broader end, in shape it is not unlike the spearhead of a warrior of the Middle Ages denuded of its point. The thoroughly defined impressions which it retains of the die, and the sharpness of its edges preclude the idea of its having been transported."

AUSTRALIAN TRIGONIAS AND THEIR DISTRIBUTION.

By W. T. Bednall.—(Communicated by Prof. Tate).

(Read June 18th, 1878).

It has occurred to me that a few remarks introducing to the notice of this Society a form of life peculiar in recent times to the Australian seas might prove interesting, especially as it is connected with a branch of Natural History, which although affording an extensive field for observation and research in this colony, is seldom taken up by members of this body, with perhaps the exception of Professor Tate, namely, Conchology.

I have the more particularly chosen the theme from the fact that it has been my very good fortune to be the first to discover the most western limit, at least so far as at present known, of the genus both on the coast of North Australia and on the southern shores of the continent.

The genus *Trigonia* was founded by Bruguiere, a French naturalist of the last century, to represent a group of bivalve shells of a triangular or three-cornered shape (as the name implies), peculiar to the secondary rocks of Europe, and at that time known only as fossils. They first made their appearance in the Lias, whence they extended through the Lower and Upper Oolite to the Cretaceous series, where they disappeared; the Tertiary formations in no part of the world but this, having produced any individuals whatever. The genus numbers but few living species, but is particularly rich in fossil representatives. Upwards of 100 species were known from the oolitic and cretaceous rocks of Europe, the United States, Chili, the Cape, and Southern India, more than twenty years ago, and now the number must be nearly double that. Australia is, however, the home of these remarkable shells in a living state, and thus adds another instance in which this great southern island-continent is the habitat of forms of life which in other parts of the globe are only found, to use Dr. Mantell's appropriate term, as "Medals of Creation."

TRIGONIA—(*Bruguiere*, 1789).

The shell is bivalve, equivalve, inequilateral, and subtrigonal; exteriorly it is strongly ribbed from the apex to the base (I am referring to the recent species only), the furrows being well defined; and interiorly it is lined with nacre or mother-of-pearl of the most beautiful and brilliant hues. But the extraordinarily intricate hinge is perhaps its most noticeable feature. It is composed of two lamelliform teeth in the right valve, which are transversely grooved on both sides, and four in the left valve, grooved on the one side only. These hinge teeth are constructed with such delicate nicety, and they fit together with such wonderful preciseness that when the shell is closed it is difficult to open it without incurring the danger of breaking the parts. The genus was divided by the late Professor Louis Agassiz into eight sections, to the last of which—the Pectinées—all the recent species belong. The first recent specimens introduced to scientific notice were collected by Péron during the expedition sent out by the First Napoleon, in the ships "Geographe" and "Naturaliste," in the year 1800. Lamarck named the new and valuable addition to the already magnificent collection of the Museum Royal, Paris, *T. pectinata*, but for some reason, of which I am unaware, it has since received the synonymous name of *T. Lamarcki* from the late Dr. Gray. Since then other species have been obtained, five being enumerated by the Messrs. Adams in their "Genera of Recent Mollusca." One more has since been added to the list by the discovery in a living state, on the south-eastern coats of Australia (not the province of South Australia), of *T. acuticostata*, originally described by Professor McCoy from fossil examples. I will now proceed to a description of the several species.

1.—TRIGONIA PECTINATA, LK.

This very beautiful shell is a native of New South Wales, and is most abundant in Sydney Harbour, where it is by no means difficult to obtain at certain spots with the dredge. The interiors of some specimens are beautifully lined with nacre of a rich silver or golden hue, while others again are, if possible, still more lovely, the tint being of the richest and most delicate pink. The shell receives its specific name from the fact that the numerous longtitudinal ribs with which it is adorned on its external surface are pectinated or combed (say like a cog-wheel). Strong transverse striations traverse the intercostal spaces from the base upwards, gradually becoming fainter as they reach the apex of the shell. I exhibit a very large variety of this species (?) dredged at Cape St. George, a

rocky headland about seventy miles south of Port Jackson, near Jervis Bay.

2.—TRIGONIA MARGARITACEA, LK.

This species was in all probability also obtained by Péron during the same voyage, the more so as it, too, has received its specific name from Lamarck. The shell, although at first sight a very similar one to the preceding, when examined carefully has many essential differences. It is a much coarser shell, more decidedly trigonal in shape, the ribs are not nearly so closely set with the comb-like projections, and the spaces between the ribs are more finely but less regularly striated, the striations not apparently extending so high up the face of the shell. The epidermis of *T. margaritacea* is also always of a much darker colour and of a coarser nature than that of *T. pectinata*, while the pearly interior is persistently of a deep purple hue. To this last characteristic it no doubt owes its name. This is one of the species to which I referred as having been found by myself at its known most western limits on the south coast of Australia. Hitherto it had only been taken in Bass's Straits, off the coast of Tasmania. It seems to have been unknown to Mr. G. F. Angas as a South Australian shell when he published his list of South Australian Bivalves in the Proceedings of the Zoological Society of November, 1865, and it must have been about that time when I obtained it on the eastern shores of St. Vincent's Gulf, on the long stretch of sandy beach between Glenelg and the Semaphore. Since then it has been found by other collectors at the same place, and further south at Aldinga, but always in a more or less worn condition. Its particular habitats in our waters have not yet been discovered, no live specimens having yet been dredged. Of the four worn valves shown by me only one is in a sufficiently good state of preservation to exhibit the colour of the nacreous interior, but the general contour of the shell and the bifurcated appearance of the process which partially emarginates the anterior muscular impression in the left valve are distinctive characters enough to show that it is a true *T. margaritacea*, and not a new species. *T. margaritacea* is catalogued by me in my list of South Australian Shells published (for private circulation only) in 1875.

3.—TRIGONIA NOBILIS—*A. Adams.*

This species is unknown to me, and I would hazard an opinion, although somewhat presumptuous on my part, that may only be a very fine example of either of the two foregoing species.

4.—Trigonia Strangei—A. Ad.

This species is one of great rarity, and was named by Arthur Adams after Mr. Fred. Strange, an enthusiastic naturalist and collector, who dredged the first specimen in deep water near the entrance to Port Jackson Heads. I have not seen an example, but I gather from Mr. Angas's List of New South Wales shells that it is distinguished from the other species by the ribs being covered with wart-like nodules. In this respect I should think it somewhat resembles *T. uniophora*, only that in that species the tubercles or nodules occur on a portion only, and not on the whole of the ribs. Mr. Angas says that a few odd valves, much worn, have been washed ashore at Long Bay and Wollongong on the coast of New South Wales.

5.—Trigonia uniophora—*Gray*.

The species described by Gray under the above name was obtained at Cape York, the most northern extremity of the Australian continent, by Mr. John Beete Jukes, naturalist of H.M.S Fly, during the scientific voyage of that vessel between the years 1842 and 1846. It is defined by Dr. Gray as a shell of a reddish-brown colour, with twenty-two or twenty-three high, rather compressed, and somewhat close diverging ribs. The upper part of the central, and the whole of the posterior ribs are covered with close, regular, transverse plates, the lower part of the central ribs with large, rounded, or oblong solid tubercles, and the hinder slope with five or six nodulose ribs. To this species must be referred the specimen found by me at the furthest known limit of *Trigonia* to the westward, on the northern coast of the continent. During a very pleasant excursion from Port Darwin to Bynoe Harbour, Indian Island, and the coral reefs in that locality, I found amongst a lot of rocky debris and broken shells a left valve of the species under remark. It is in a much worn state, but quite good enough for the purposes of identification.

6.—Trigonia acuticostata.—*McCoy*.

Habitat.—South-eastern coast of Australia. I will refer to this species presently.

Up to the present time no representative of the genus has been received from the western, north-western, or south-western shores of Australia, but there can be little doubt that it will be taken eventually when collecting and dredging are more systematically carried on in these

waters. The time, however, may be distant, as the coast is little settled upon, except in the neighbourhood of Swan River. There is the more probability of its being found seeing that the genus is thoroughly Australian as a recent form, and also from the fact that the mollusc itself is migratory in its habits. Like many other bivalve molluscs, *Trigonia* is able to make considerable leaps by means of its powerful wedge-shaped foot; and Woodward in his "Manual" mentions an instance in which a specimen, placed by Mr. Stutchbury on the gunwale of his boat, leaped overboard, clearing a ledge four inches in height. Neither is there any record of the existence of *Trigonia* in the seas of New Zealand; but perchance time may add it to the already extensive fauna of the shores of that country also. The recent *T. pectinata* of the adjacent coast of New South Wales is found as a fossil in the upper miocene rocks of New Zealand.

I will now briefly refer to Trigonia as a fossil in Australia, and for numerous references and notes, and very complete information, mostly obtained by his own personal observation, I am indebted to Professor Tate.

Seven fossil species are known—two from Jurassic, one from cretaceous, and four from tertiary strata. In point of age, the first to be mentioned are the two Jurassic species, as in them we have contemporaneous representatives of the genus *Trigonia* when it first made its appearance in the ever-developing scheme of Creation.

1. T. MOOREI, *Lycett.*, Western Australia, allied to *T. costata* of the European Oolite; and

2. T. LINEATA, *Moore*, Wollumbilla, Queensland. Both these species are described in the Jour. Geol. Soc., Vol. xxvi., 1870.

Next in geological sequence comes the cretaceous form.

3. T. NASUTA, *Etheridge*, from Maryborough, Queensland. It is allied to *T. alæformis*, and belongs to a type not known in the Jurassic rocks.

We now come to the Tertiary species, the forms, as a consequence, having the closest affinity to the recent species referred to in the earlier part of the paper.

4. T. SEMIUNDULATA, *McCoy*. Prodromus of the Palæontology of Victoria Decade, II. t. 19, f. 1—2, pl. 21.

Professor McCoy says this shell is "easily distinguished from any known recent or tertiary species by the rippled appearance produced by the undulated concentric ridging of the anterior two-thirds of the valves.

The transverse edging, though common in the Mesozoic Trigoniæ, is not found in the recent species." The sculpture of this shell leads to the assumption that in it we have a continuation of the style of ornamentation peculiar to forms of the genus belonging to the secondary rocks into the succeeding strata of the Tertiary system. It will be seen, too, that *T. semiundulata* has a wider range geographically than any other, being recorded from South Australia, Victoria, Tasmania, and New Zealand, and also that it has not been found in a later division of the Cainozoic period than the Upper Miocene. It has been found in the

Miocene—Bird Rock Bluff, Victoria (*McCoy*), Muddy Creek, Hamilton, Victoria (*Tate*), Gawler, South Australia (*Tate*), Table Cape, Tasmania (*R. M. Johnston*, Pro. Ryl. Soc., Tas., 1876).

Upper Miocene—Arramoa, New Zealand (*Hutton*, Cat. Ter. Mol., N.Z,, 1873).

5. T. HOWITTI (*McCoy*), l. cit., Decade III., t. 27, f. 3, pl. 31, 1876.

Loc. Sandy marl, Jemmy's Point, near the entrance to the Gippsland Lakes.

6. T. ACUTICOSTATA—(*McCoy*)—l. cit. Decade II., t. 19, f. 1-2, pl. 21.

"*T. acuticostata*," remarks the author, "is easily distinguished from the recent species by the remarkable compression of the ribs into acute angular ridges, and from the same cause the spinous tubercles do not form the broad blunt transverse tubercles which they do in the recent species." Since the above remarks were written some years ago, for *T. acuticostata* appears to have been the earliest Tertiary species discovered, it has been found living on the south-eastern coast of Australia. The localities from which it is recorded are :—

Miocene.—Muddy Creek, Hamilton, Victoria (*McCoy*). Cliffs, River Murray, North-West Bend (*Tate*). Casts, probably of *T. acuticostata*, occur in beds of the same age at Tickera, Yorke's Peninsula, and at Aldinga, South Australia (*Tate*).

Pliocene.—Mordialloc, Hobson's Bay, Victoria.

7. T. PECTINATA, *Lk.*

Upper Miocene.—Hampden, New Zealand (*Hutton*, Cat. Ter. Mol. N.Z., 1873.)

From the above-mentioned observations we obtain the following table of the geographical and geological range of the Trigonia in Australia :—

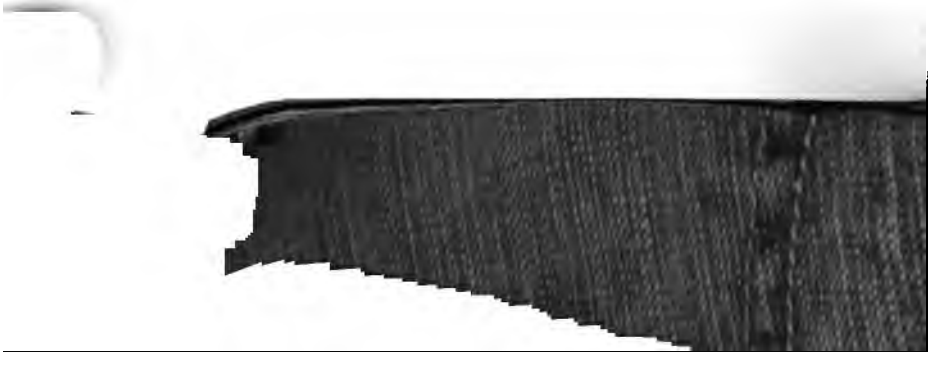
	Lias.	Oolite.	Cretaceous.	Tertiary.	Living.
All other Countries except Australia	Say 200 Sp.			—	—
Australia	2		1	3	6
New Zealand	—		—	2	—

It will be noted from this table that the genus was excessively rich in representatives from its advent at the beginning to the close of the Secondary Age in Europe, when it died out altogether; whereas in Australia it has survived throughout the whole period of secondary and tertiary periods until the present day, though it must be admitted in a very limited degree in regard to number. I will now add a list of all known Australian Trigonias:—

1. T. Moorei	Mesozoic.	Jurassic	Western Australia.
2. T. lineata	Mesozoic.	Do.	Queensland.
3. T. nasuta	Mesozoic.	Cretaceous	Queensland.
4. T. semiundulata	Cainozoic.	Miocene	Victoria; South Australia; Tasmania.
	Cainozoic.	Up. Miocene	New Zealand.
5. T. Howittii	Cainozoic.	——	Victoria.
6. T. acuticostata	Living and Cainozoic.	Miocene	Victoria; South Australia.
	Living and Cainozoic.	Pliocene	Victoria.
	Living and Cainozoic.	Living	South-Eastern Australia.
7. T. pectinata	Living and Cainozoic.	Up. Miocene	New Zealand
	Living and Cainozoic.	Living	New South Wales.
8. T. margaritacea	Living.	Do.	Tasmania; South Australia.
9. T. nobilis	Living.	——	——
10. T. Strangei	Living.	Living	New South Wales.
11. T. uniophora	Living.	Do.	Tropical N. and N.E, Australia.

In conclusion, I would remark that independently of the scientific interest attaching to the shells I have been speaking of, the casual observer when he sees them must be involuntarily impressed with their beauties and peculiarities. When first discovered at the beginning of the present century in the seas of New Holland they were considered such a rarity by collectors that large prices were given even for old and worn single valves, no better than some of those shown by me. At the present day

the perfect shell is much prized by collectors, and finds a deservedly honourable place in their cabinets. The jewellers, too, have not lost sight of its pearly brilliance, and have successfully turned it to account in the manufacture of elegant trinkets, such as brooches, eardrops, and the like. Whether the attention is most attracted by the brilliant iridescent hues of the nacreous interior, or the wonderful complication of the remarkable hinge with which the valves are closed, the shell of Trigonia must always prove an object of interest to all lovers of the beauties of Nature in her ever-varying never-ending kingdom of wonders.



THE RECENT MARGINELLIDÆ OF SOUTH AUSTRALIA.

By Prof. R. Tate, Assoc. Lin. Soc.; F.G.S., London, &c.; Cor. Mem. Acad. Sc., Phil.; Roy. Soc., Tasmania, &c.

[Read June 18, 1878.]

The occurrence of the family *Marginellidæ* in the South Australian seas has hitherto been unrecorded.

Species of *Marginella* have been known to inhabit the eastern shores of this continent, whilst the sub-genus *Hyalina* was first recorded in 1871, and *Erato* in 1877, as Australian. Examplar species of each of these have been found by me in our waters. They are eight in number: five of *Marginella*, two of *Hyalina*, and one of *Erato*. Two of the Marginellas are identified with known species, but the others I believe to be undescribed.

FAM. MARGINELLIDÆ.—GENUS MARGINELLA.

1.—Marginella Volutiformis (*Reeve*).

Conchologica Iconica. Monograph of Marginella, tab. 24, f. 131, 1865.

An ovate, ivory-white shell, body whorl swollen above, lip varicosely reflected, *columella quadriplicate*. Length, ·3; breadth, ·18 inch.

Washed on shore.—Cape Northumberland (many examples) and Middleton (*Tate*), South-East Coast (*Bednall*, one ex.) It is somewhat common in Tasmania (*Woods*), and I have received specimens from Portland, Victoria.

2.—MARGINELLA TURBINATA (*Sowerby*).

Thes. Conch., t. 75, f. 70, p. 385; Reeve, loc. cit., t. 22, f. 122.

A solid, whitish, shining shell, with a short spire, and faintly crenulated round the upper part of the whorls. Length, ·45; breath, ·3 inch.

Washed up.—Cape Northumberland (*Tate*), Guichen Bay (*Smeaton*), many examples.

It occurs at Portland, Victoria; is rare in South Tasmania (*Woods*), and has been dredged in Port Jackson (*Angas.*) The South Australian examples are very much larger than those from New South Wales, the dimensions of the latter being, length ·35, and breadth ·2 inch.

3.—MARGINELLA SUBBULBOSA (new species).

Shell shining white, rather solid, having much the shape of *M. turbinata*, but more regularly convex from apex to front; apex obtuse; faintly striated transversely. External lip thickened slightly inflected, minutely denticulated within; columella quadriplicate; plaits equi-distant, the anterior two the larger. Length, ·15; breadth, nearly 1 inch.

It has some resemblance to *M. Bensoni* (Reeve), which has a triplicate columella; and to *M. bulbosa* (Reeve), agreeing with it in its quadriplicate columella and denticulated lip, but differing in its more prominent spire.

Washed Up. — Wauraltie, west side of Spencer's Gulf, two examples (*Tate*).

4.—MARGINELLA CYMBALUM (new species).

Shell shining white, rather solid, ovately-globose, spire immersed; columella plicate throughout, plicæ about 12, the anterior six stout, the rest not so conspicuous; outer lip thick and smooth. Length, ·2; breadth, ·14 inch.

This species belong to the Section *Cryptospira*, wherein the last whorl is produced over the spire as in the genus *Ovulum*; its nearest ally is *M. pisum* (Reeve), from which it differs in its a little less globose shape, and in having many plaits on the inner lip, there are only four in that species. *M. pisum* is recorded by Reeve as simply from Australia, but it has recently been catalogued by Mr. Brazier from the north-east coast of the continent. Another Australian *Cryptospira* is *M. ovulum* (Sowerby), but its elongately oval form is a distinguishing character; the Tasmanian species *M. minutissima* (T. Woods), has a triplicate columella.

Washed up.—Aldinga Bay, St. Vincent's Gulf, ten examples (*Tate*).

5.—MARGINELLA DENTICULATA (new species).

Shell shining white, pear-shaped, contracted in front, spire immersed; *columella quadriplicate*, outer lip thickened and minutely denticulated. Length, ·08; breadth, ·06 inch.

Its pyriform shape separates it from *M. pisum* and *M. cymbalum*, but it has more agreement in this particular with the Bornean *M. dens* (Reeve); its denticulated outer lip and strong columella plaits separate it from all.

Washed up. — Wauraltie, west coast of Spencer's Gulf, three examples (*Tate*).

6.—MARGINELLA TRIDENTATA (new species).

Shell elongately conical, yellowish white, shining; spire somewhat exserted; last whorl rather swollen round the upper part, attenuated in front; lip broadly thickened, opaque, moderately inflected in the middle region, flexuous, minutely denticulated on the inner edge; columella with three strong plaits. Length ·25, breadth ·15 inch.

Washed up.—Aldinga Bay, St. Vincent's Gulf, one example (*Tate*).

I do not hesitate to found a new species upon the unique specimen before me, because it presents a combination of characters—a triplicate columella, denticulated lip, with a narrow conical shape, not presented by any known form. Its nearest ally is *M. sordida* (Reeve), from which it differs in being proportionately a little broader, and in having a denticulated outer lip. *M. Tasmanica* is the only other Australian species with a triplicate columella, but its shape is widely different from the present species.

7.—MARGINELLA ALBIDA (new species).

Shell semi-transparent, whitish, oblong-cylindrical, surface marked with regular striæ of growth; spire very short, apex obtuse; base rounded, slightly attenuated; aperture narrow, widening to the front; columella a little arcuate anteriorly with five plaits, the anterior two of which are thick; outer lip thickened, flatly varixed behind, and finely dentate on the inner edge with about twenty teeth. Length 2, breadth ·1 inch.

This species may be characterised as a diminutive, white, *Hyalina pallida*, Linne, with a five-plaited columella. Only two other forms of

the genus are known in the Australian seas—*H. mustellina* (Angas) Proc. Zool. Soc., London, 1871 t.1., f.5., which is banded with grey and brown and has a quadriplicate columella; and H. *fusiformis* (Hinds) with a conical spire and quadriplicate columella.

Among shell sand from the Marino Beach, Holdfast Bay; and Aldinga, St. Vincent's Gulf. (*Tate*); two examples.

GENUS ERATO.

8.—Erato bimaculata (new species).

Shell minute, ovately pyriform, pale primrose-yellow to yellowish white, with rufous-red around the extremity of the anterior canal and on the callous border to the hinder part of the aperture; body whorl swollen, constricted at the base; outer lip stoutly swollen, extending to the apex of the spire, with about twenty-five strong, transverse plicæ; aperture very narrow, curved, emarginate posteriorly; columella with eight crowded transverse plaits. Length ·17, breadth ·12 inch.

E. bimaculata closely resembles *E. angulifera* (Reeve) from Borneo, but it has a less angular and inflated body whorl, and the colouration is peculiar. Three other species are known to inhabit the Australian seas, but they have little affinity with our shell.

Washed Up.—St. Vincent's Gulf at Aldinga and Marino, six examples (*Tate*); at the Semaphore, one example (*Bednall*), on the East Coast; and at Surveyor's Point on the West Coast, two exs. (*Tate*). Spencer's Gulf at Wauraltie, one ex. (*Tate*).

Reeve's "Monograph of *Marginella*" was concluded in January, 1865; it includes descriptions and figures of 15 species, which were then or are now known to be Australian, in a little more than a decade the number has been doubled. At the present time 185 species at the least are living chiefly in tropical seas, but extending into warm temperate regions in the Mediterranean, California, S. Africa, and Australasia. Of the 32 species recorded for Australia five only belong to the tropical part, and the large number of 27 extra-tropical forms makes this area the chief centre of habitation of the genus in so far as regards the temperate portions of the ocean; and in tertiary times it would appear to have been the focus of distribution of the genus.

The geographical distribution of the Australian species of the family Marginellidæ is shown by the accompanying table; from which we learn

that a majority of the species is confined to the south-east of Australia, and that two only are at all somewhat widely distributed.

TABLE SHOWING THE DISTRIBUTION OF THE AUSTRALIAN MARGINELLIDÆ.

NAMES OF SPECIES.	AUTHORS.	N&N E AUST.	WEST AUST.	STH. AUST.	VICTORIA	TASMANIA.	N. S. WLS.
Marginella australis ...	Hinds	•					
(H) fusiformis	Hinds	•					
guttula	Reeve	•					
lævigata	Brazier	•					
(C) pisum	Reeve	•					
liturata	Menke		•				
De Burghiæ ...	Reeve		•				
(H) albida	Tate			•			
(C) cymbalum ...	Tate			•			
(C) denticulata	Tate			•			
subbulbosa... ...	Tate			•			
(H) tridentata ...	Tate			•			
turbinata	Sowerby			•	•	•	•
Volutiformis ...	Reeve			•	•	•	
Allporti	Woods					•	
formicula	Lamarck				•	•	
muscaria	Lamarck					•	•
Stanislas	Woods					•	
Tasmanica	Woods					•	
(C) minutissima ...	Woods					•	
Angasi	Crosse						•
attenuata	Reeve						•
Metcalfi	Angas						•
(H) mustellina ...	Angas						•
ochracea	Angas						•
olivella	Reeve						•
(C) ovulum	Sowerby						•
(C) pulchella	Kiener						•
rufula	Reeve						•
simplex	Reeve						•
Strangei	Angas						•
translucida... ...	Sowerby						•
Erato angyostoma ...	Sowerby	•					•
gallinacea	Hinds	•					
bimaculata ...	Tate			•			
corrugata	Hinds						•
Total	36	7	2	8	3	8	16

THE FOSSIL MARGINELLIDÆ OF AUSTRALASIA.

By Prof. R. Tate, Assoc. Lin. Soc.; F.G.S., London, &c.; Cor. Mem. Acad. Sc., Phil.; Roy. Soc., Tasmania, &c.

[Read June 14, 1878.]

The family is not known in rocks of older date than the Eocene. The number of fossil species given for each genus in Woodward's Mollusca, 1866, is: Marginella and Hyalina, 30; Volvaria, 5; Erato, 2. Doubtlessly some additions have been made since that date, and the list is now increased by the 18 species from the Australasian Tertiaries which are enumerated in this paper. The large proportion that these bear to the known fossil forms justifies the assertion made in the last paper that the Australian area was the chief centre of habitation of the family in the Tertiary period.

DESCRIPTION OF SPECIES—GENUS MARGINELLA.

I. Outer lip smooth.

(1) Columella quadriplicate.

1.—Marginella Aldingæ (new species).

Shell very small, somewhat fusiformly ovate, shining; spire, short, obtuse; whorls $4\frac{1}{2}$, nuclear whorls rounded smooth, the anterior two angulated, ornamented with nodulose plications at the angle and strong striæ; there are about twelve plications on the last whorl, which are evanescent towards the front and the suture; aperture narrow, sigmoid; outer lip much thickened and reflected, and deeply channelled above, without denticulations; columella quadriplicate. Dimensions—Length, 0·125; breadth, 0·1.

Very different from any living form, but recalls the West African harpæform Marginellæ, all of which are more fusiformly ovate.

Locality and Horizon.—Eocene marls, Blanche Point, Aldinga, South Australia, (*Tate*) many examples.

2.—Marginella Cassidiformis (new species).

Shell small, rather solid, cream-coloured, shining; ventricose-shaped like a typical *Cassis*, ornamented with plications on the shoulder of the whorl, fourteen on the last whorl. Aperture narrow oblong; outer lip straight, thick, and channelled above; columella quadriplicate, the anterior two oblique, the other two transverse. Dimensions: —Length, ·18; breadth, ·14.

Differs markedly from *M. Aldingæ* in shape and form of aperture, &c.

Locality and Horizon.—Miocene, Muddy Creek, near Hamilton, Victoria (*Tate*, 4 exs).

3.—Marginella muscarioides (new species).

Shell small, volutiform, shining cream-coloured, and obscurely marked with several narrow longtitudinal bands of dark colour. Spire conspicuously exserted; whorls regularly convex, last whorl gibbous slightly angled over the suture, transversely striated, and in some examples obscurely plicated at the angle. Aperture wide, curved posteriorly, and dilated anteriorly; outer lip moderately thickened, ivory white, smooth, and strongly channelled above, not extending on to the penultimate whorl. Columella with four strong plaits. Dimensions: —Length 0·275, breadth 0·15

This species is a diminutive *M. muscaria*, Lamk., from which it differs in certain minute but constant details.

In *M. muscaria* the callous lip is proportionately thicker, and ill-defined above, but a more particular difference is its extension on to the penultimate whorl, thence spreading over the base of the shell and giving rise to a flattened appearance varicosely margined on the left side. The under side of *M. muscarioides* is regularly convex, and the posterior angle of the aperture is squarish.

Locality and Horizon.—Miocene, Muddy Creek, Victoria, (*Tate*) many examples.

4.—Marginella hordeacea (new species).

Shell small, broadly ovate; spire short obtuse; last whorl regularly convex above, slightly depressed on the under side. Outer lip very thick and strongly channelled above, inner edge smooth; columella

with four strong distant plaits. Dimensions.—Length 0.225, breadth 0.175 inch.

M. infans (Reeve) makes some approach to *M. kordacea*, but there is no recent species so broadly ovate as it. The flatted underside and the thick lip give it a striking character.

Locality and Horizon.—Miocene limestones, upper part of Blanche Point Cliff, Aldinga, South Australia. Very abundant (*Tate*).

5.—MARGINELLA DUBIA (*Hutton*),
Cat. Tertiary Moll. of New Zealand, 1873, No. 52, p. 8.

"Ovato-cylindrical, spire short, smooth; outer lip slightly thickened; axis, ·6; breadth, ·3.

"Upper Eocene.—Broken River, Chatham Islands, N.Z." (*Hutton*)

6.—MARGINELLA ALBESCENS (*Hutton*),
Cat. Marine Moll. of N.Z., 1873, p. 19, No. 65.

"Shell small, oval, translucent; spire short; aperture narrow; columella with four plaits, white. Length, ·2; breadth, ·1.

"Upper Miocene. — Awamoa; and Recent, New Zealand" (*Hutton*).

II. Outer lip dentate.

(1) Columella quadriplicate.

7.—MARGINELLA WENTWORTHI (*Tenison Woods*),
Proc. Roy. Soc., Tasmania, p. 109, 1877.

"Shell small, ovately oblong, tumid, smooth, shining; spire exsert obtuse; whorls five, roundly angulate; aperture narrow, oblong; outer lip much thickened, deeply channelled above, enamelled on the edges, with numerous small tubercular teeth within the margin; columella with four plaits; anterior aperture widely channelled."

Locality and Horizon. — Miocene, Table Cape, Tasmania.—(*Johnston*).

Miocene.—Muddy Creek, Victoria (*Tate*), and R. Murray Cliffs (*Tate*).

Eocene Marls.—Blanche Point, Aldinga, South Australia (*Tate.*) Common in all localities.

M. Wentworthi has some resemblance to *M. muscaria*, differing from it not only as *M. muscarioides* does, but in its denticulate lip and more lanceolate form. But for its shorter spire it might be mistaken for

M. eburnea of the Paris basin, which has however a smooth lip. The shell varies much in its size; the dimensions of extreme forms from Muddy Creek are

	Length	0·34	Breadth	0.16 inch
	"	0·19	"	0·12 The Aldinga specimens
are stouter	"	0·29	"	0·18

8.—MARGINELLA STROMBIFORMIS (*T. Woods*), loc. cit., p. 109.

"Shell small, solid, smooth, shining, ovate, narrowed anteriorly, spire short obtuse, whorls four, rounded; body whorl obscurely longitudinally plicate below the suture; columella anteriorly obliquely somewhat coarsely quadriplicate; aperture narrow, curved, posteriorly emarginate, outer lip conspicuously thickened and produced posteriorly, finely tuberculately dentate within. Length, ·275; breadth, ·12 inch.

Not unlike a minute Strombus viewed from above owing to the produced lip; it is nearest in form to the W. Indian *M. marguerita*, Kiener, but that is a somewhat larger and more angular shell."—(*Tenison Woods*).

Locality and Horizon.—Miocene, Table Cape (*Johnston.*)

9.—MARGINELLA MICULA (new species).

Shell minute, milk-white smooth, shining, conically ovate; spire very small obtuse; body whorl gibbous over the suture and constrictedly attenuated anteriorly; outer lip produced posteriorly slightly thickene; and minutely denticulated; aperture wide, curved, posteriorly emarginated columella four-plaited, plaits distant. Length ·11, breadth ·085 inch.

Locality and Horizon.—Miocene—Muddy Creek, Victoria. (*Tate*); many examples.

M. micula is near in form to the W. African *M. vitrea* (Hinds) but has a smaller spire and is more attenuated; it, moreover, belongs to a different section of the genus. So much as *M. vitrea* differs in form from *M. marguerita*, so does *M. micula* differ from *M. strombiformis.*

10.—MARGINELLA INERMIS (new species).

Shell ovate to somewhat pear-shaped, attenuated anteriorly, smooth and shining, spire very short; aperture oblong, strongly arched posteriorly; outer lip slightly varied, edge thin and inconspicuously denticulated; columella quadriplicate. Length, ⅛; breadth, ¼-inch.

Locality and Horizon.—Miocene—Muddy Creek, Victoria. (*Tate*) seven examples.

11.—MARGINELLA VENTRICOSA (*Hutton*).

Cat. Tertiary Moll., No. 53, p. 8.

Ovato-ventricose: spire very short, smooth, outer lip thickened, strongly dentate; columella plaited. Axis, ·65; breadth, ·5.

Eocene—Broken River (*Hutton*).

(II.) Outer lip dentate.

2 Columella quinqueplicate.

12.—MARGINELLA WINTERI (new species).

Shell narrowly oblong, smooth and shining; spire exserted subacute, aperture triangular, moderately wide in front; outer lip white, rather flexuous, thinly but broadly thickened and somewhat inflected, with about 30 small obtuse denticles. Columella 5-plaited; the posterior one is small and absent in young shells. Length, $\frac{1}{2}$; breadth, ·35 inch.

The shape is much that of *M. bibalteata* (Rv.), and is narrower and more acute than *M. serrata* (Reeve), both of which have quadriplicated columellas.

Locality and Horizon.—Miocene—Muddy Creek, Victoria (*Tate*) many examples.)

I associate with this species the name of S. P. Winter, Esq., of Murndal, on the Wannon, as a slight recognition of the aid he has rendered to myself and other investigators of the palæontology of the Muddy Creek beds.

13.—MARGINELLA PROPINQUA (new species).

Shell oblong-cylindrical, solid, light horn coloured, transversely streaked with white, enamelled; aperture triangular, with a broad milk-white varix strongly denticulated on the bevelled edge; columella five-plicate. Length, ·45; breadth, ·22 inch.

It differs from the foregoing in its short spire and more tumid body whorl. In form it agrees with *M. Philippinarum* (Redfield), which is quadriplicate.

Locality and Horizon.—Miocene—Muddy Creek, Victoria, many examples; upper beds of the River Murray Cliffs (*Tate*).

14.—MARGINELLA WOODSI (new species).

Shell solid, enamelled, cream-coloured, ovately oblong; spire short, obtuse; whorls rotundly angulate; aperture narrowly oblong,

rounded posteriorly; outer lip white, broadly thickened, channelled above, subsigmoid and denticulated within; columella with five plaits, the posterior one small. Length, ·3; breadth, ·175 to ·2 inch.

Has affinity with *M. Wentworthi* and *M. muscarioides*, being somewhat intermediate in form, but larger than both, and is distinguished by its short spire, and 5-plicate columella; it is more oblong than *M. Wentworthi*, and more attenuated anteriorly than *M. muscarioides*, and is moreover dentate.

Locality and Horizon.—Miocene—Muddy Creek, Victoria. (*Tate*) many examples.

This species is dedicated to the Rev. J. E. Tenison Woods, F.G.S., whose name is most intimately associated with the coral fauna of the Muddy Creek beds.

II. Outer lip dentate.

3. Columella septemplicate.

15.—MARGINELLA SEPTEMPLICATA (new species.).

Shell stoutly ovate, gibbosely convex, light horn colour, shining; spire immersed, outer lip broadly but thinly callous, the callosity extending all round the aperture, denticulated within; columella with seven broad plaits. Length, ·375; breadth, ·23 inch.

Locality and Horizon.—Miocene—Muddy Creek, Victoria. (*Tate*) 4 exs.

No living species has the form, size, and columella plications of *M. septemplicata*; it belongs to the section *Persicula* of Schumacher.

GENUS VOLVARIA.

15.—VOLVARIA FICOIDES (*Hutton*).

Cat. Foss. Moll. of New Zealand, p. 8.

Ovato-pyriform; smooth; whorls four; spire not exserted, aperture narrow, outer lip inflected; columella quadriplicate. Axis, 1·1; breadth, ·85.

Upper Eocene.—Oamaru, New Zealand (*Hutton.*)

GENUS ERATO.

16. ERATO? OCTOPLICATA (*Woods*).

Ref. *Marginella octoplicata*, Proc. Roy. Soc., Tasmania, 1877, p. 109.

"Shell solid, smooth, shining, pyriform; spire scarcely visible,

of three very small depressed whorls; body whorl distinctly striated with lines of growth; mouth narrow, subsigmoid; columella with eight plaits, the anterior valid scarcely oblique, the posterior four faintly traceable, outer lip much thickened, and very regularly dentate with 12 raised linear teeth; at the base of the columella there is a distinct varix, which proceeding round the posterior end of the shell unites with the reflected lip, making that broadly marginal. It bridges over the gap between *Marginella* and *Erato* and *Cypraea*. *Marginella 5-plicata*, Lam., *M. elegans* (Gmel.) and *M. turbinata* (Sow.) show an approach to this form, but they are larger shells."

Unacquainted with the species I cannot pronounce upon its generic affinities, but from its diagnosis it would appear to be rather an *Erato* than a *Marginella*.

Horizon and Locality.—Miocene; Table Cape, Tasmania (*Johnston*.)

17.—Erato Australis (new species).

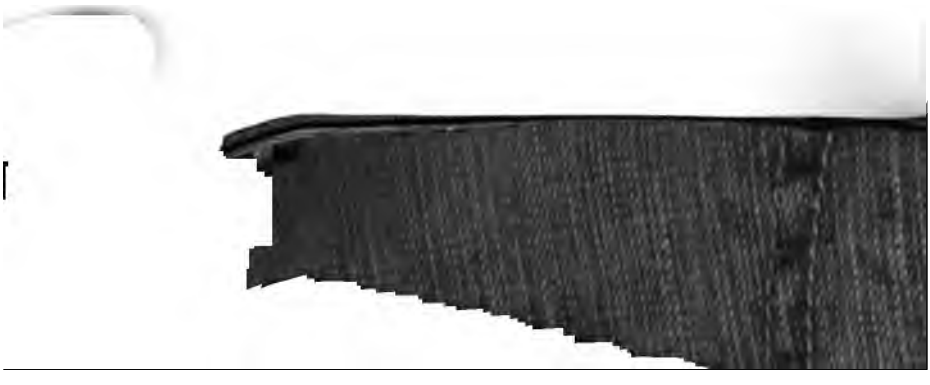
Shell minute, shining, horn-colour; tringularly pear-shaped; spire rather exserted somewhat acutely conical; whorl 4½, body whorl marked with lines of growth, rotundately angled over the suture, and constrictedly attenuated in front; outer lip moderately thickened and inflected, inner margin denticulated; aperture moderately wide, enlarged behind and narrowing to the front; columella with four slender oblique plaits succeeded by denticles. Length, 0.23; breadth. 0.15 inch.

E. Australis is seemingly related to the above, but separable by its exserted spire, in which character it agrees with *E. gallinacea*, Rv. from the Philippines, and *E. callosa*, (Adams and Rv.) from the Chinese Seas, differing from them in its narrower shape, and less inflated body whorl.

Locality and Horizon.—Eocene marls at Blanche Point, Aldinga South Australia (*Tate*), fifteen examples.

18.—Erato minor (new species).

Shell minute, somewhat elongately pyriform, orange yellow, spire short obtuse; outer lip shining white, with a broad callous expansion posteriorly, extending over the penultimate whorl and enveloping the base of the shell; columella with five conspicuous plaits and denticles. Resembles the living *E. Sandwicensis*, (Pease,) but the aperture is not so prolonged posteriorly, and the spire is much shorter Dimensions.—Length 0·15, breadth 0.1 inch.



Locality and Horizon.—Miocene, Muddy Creek, near Hamilton, Victoria (*Tate*), 4 exs.

Divisions of the genus *Marginella* have been proposed by several conchologists; these are founded chiefly upon the character presented by the spire, whether elevated or hidden, whilst the outline of the shell has served for further subdivision Were I to adopt the divisions proposed by the MM. Adams, I should be necessitated to suggest others for the reception of certain of the fossil forms; not deeming this desirable, I select more stable characters those of the plication of the columella, and the absence or presence of denticles on the lip, as bases for the arrangement of the species into artificial groups to facilitate reference, such as is set forth in the following conspectus.

CONSPECTUS OF THE SPECIES OF FOSSIL MARGINELLÆ.

I. Outer lip smooth; columella quadriplicate.
1. Fusiformly ovate, *M. Aldingæ*, Tate.
2. Ovate ventricose, *M. Cassidiformis*, Tate.
3. Volutiform, *M. muscarioides*, Tate.
4. Broadly ovate, *M. hordeacea*, Tate.
5. Ovato-cylindrical, *M. dubia*, Hutton.
6. Oval, *M. albescens*, Hutton.

II. Outer lip dentate.

A.—Columella quadriplicate.

7. Ovate-oblong, *M. Wentworthi*, T. Woods.
8. Ovate, *M. strombiformis*, T. Woods.
9. Conically-ovate, *M. micula*, Tate.
10. Pyriform, *M. inermis*, Tate.
11. Ovate-ventricose, *M. ventricosa*, Hutton.

B.—Columella quinque-plicate.

12. Fusiformly oblong, *M. Winteri*, Tate.
13. Oblong-cylindrical, *M. propinqua*, Tate.
14. Ovate-oblong, *M. Woodsi*, Tate.

C.—Columella multiplicate (*Section Persicula.*)

15. Columella 7-plicate, *M. septemplicata*, Tate.

Remarks on the Affinities of the Species.—Of the fifteen species enumerated in the foregoing table, only one is known as a living shell, it is *M. albescens*, which inhabited the same region in Miocene times as it does now. Three have allied species among recent forms :—

M. hordeacea resembles *M. infuma*, of Singapore.
M. muscarioides „ *M. muscaria*, of S. E. Australia.
M. strombiformis „ *M. maryuerita*, of the West Indies.

Then there are five species which are only distantly allied to, though resembling certain living forms, because their essential points of difference are less trivial than variation of shape; these and their living analogues are as follows :—

Fossil Species.	Recent Species.
Outer lip of shell dentate.	*Outer lip smooth.*
M. Wentworthi is the analogue to	M. muscaria, S.E. Australia.
M. micula „ „	M. vitrea, W. Indies.
Columella 5-plicate.	Columella 4-plicate.
M. Winteri is the analogue to	M. bibalteata, W. Indies.
M. propinqua „ „	M. Philippinarum, E. Indies.
M. Woodsi „ „	M. volutiformis, S.E. Australia.

Analogous forms to certain other of our Tertiary fossils have been indicated by McCoy and Duncan in the genera *Voluta* and *Cypræa*, and among some of the corals and echinoderms.

Our tertiary fauna, so far as it has been critically studied, shows an affinity rather with the recent fauna of the East Indian and Chinese Seas than with that of temperate Australia. However, this phenomenon is not exhibited by the Marginellidæ, at least only in a very slight degree, and their alliance is as strong with the West Indian and Australian faunæ. In respect to the West Indian fauna, it may be stated that it possesses many points of affinity with that of the Miocene of Europe.

WHIRLWINDS.

By Otto Tepper, Corresponding Member.

[Read July 16, 1878.]

By whirlwinds are understood local disturbances in the atmosphere, of limited diameter, and moving in a spirally-ascending direction, at the same time shifting laterally.

They are during the summer months of such frequent occurrence in Australia and elsewhere that many people do not deign to take much notice of them unless their attention is enforced by some specially destructive whirlwind. Yet the *causes* of these phenomena appear so much enveloped in mystery that the careful observation and study of them may well repay for the pains taken, as perhaps through these phenomena the origin of the far grander waterspout and cyclone may be elucidated.

A. v. Humboldt considers them as effects of opposing currents; but how currents moving in *straight* lines with moderate velocity can produce spiral ones endowed with great swiftness it is hard to comprehend, even leaving out of question the fact that whirlwinds only take place during almost absolute calms.—(Belt, "the Naturalist in Nicaragua.")

Maury, again, ascribing them also to the meeting of currents, invokes the aid of electricity, citing an experiment with a metallic ball, by means of which, when highly charged with electricity, a small waterspout was raised ("Geogr. of the Sea"). The objection to lateral currents being the cause having been stated, electricity as such is equally doubtful, it being hardly conceivable, in the absence of such powerful concentrating agent as a *metallic* ball how thousands of tons of water could be raised for hundreds of feet by any *known* natural agent. Besides this, it seems that whirlwinds occur as frequently as not in nearly dry atmosphere, with little indication of electric tension and *before* any thunder

clouds form. They appear rather to act as producers of the concentration of electricity in the clouds than otherwise, but when taking place under an overcharged cloud no doubt act as channels of exchange and discharge, and in this way—two forces acting conjointly—their effectiveness would be increased immensely.

To get a fair understanding of the phenomena, the following points must be considered, viz.:—

1. The time of day they take place.

2. The accompanying circumstances.

3. The actual facts observable—*a*, at the start; *b*, during progress; *c*, at the end.

4. The *mechanical* agencies, by means of which the observed facts can be explained.

In no instance can I remember ever to have witnessed a real whirlwind either much before 10 a.m. or after 4 p.m.; the period of maximum frequency being between noon and 3 p.m., thus limiting their occurrence to the hours of maximum daily temperature. By this observation it is not implied that they *cannot* occur at some other time (for I have noticed often small momentary whirling gusts at other times, when obstructions of peculiar form offered themselves to the winds), but that their normal occurrence falls within the periods named.

The *weather* at the time is distinguished by calm, intercepted by short, fitful blasts of wind from every point of the compass irregularly, and considerable warmth. If a *hot wind* is prevalent at the time, whirlwinds invariably occur in a temporary lull. In respect of size they range from a few inches in height and diameter, over an ash-heap or in large fireplaces, to lateral dimensions of several hundreds of feet, and vertically to several thousands of feet in elevation.

The producing causes may be found in the sudden temporary escape of overheated air, when in unstable equilibrium, through a resisting medium, viz., a stratum of denser, colder, rapidly-moving current above. By this escape a partial vacuum being formed, the gravitation of the surrounding still air will assist in forcing the lower strata directly under the vent, powerfully up and towards the same, by which means the increased force of the whirling current can be easily accounted for.

The effect of the upper polar current upon the ascending heated air particles is very great, because there is a mechanical law, according to which a fluid or gas in rapid motion acts to some extent like a solid in pre-

venting other fluids at rest or only moving slowly from entering or mixing with each other. As far as fluids are concerned this is illustrated in a grand scale by the oceanic currents, and by the ease a sharp stream of gas or vapour can be ejected to some distance through some other without mixing. Claiming the same property for the upper aerial currents (which must acquire a considerable momentum, being entirely unimpeded in their course, and therefore offer a great resistance by their inertia to any intrusion), they will act as a barrier to the ascending particles of heated air, infringing upon the swift cool current at right angles or nearly so, and thus are arrested in their course and detained, as illustrated in Plate 3, fig. 1. Air being a bad conductor of heat the warm particles will be very slow in parting with it, especially to others in rapid motion, and therefore long retain their buoyancy. A certain tension, a pressure exerted by them upon the barriers would therefore result and increase continually, though in a slow ratio Gradually the atmosphere would grow hotter, the upward pressure stronger, the area of the calm extended, and the upper current forced upward in the places of maximum pressure, as shown in fig. 2, plate 3.

In the meantime the air becomes more and more oppressive, and to some extent charged with moisture. The heat becomes *visible*, the whole lower strata of the atmosphere seem quivering, undulating, strangely distorting distant objects. The combat of the forces is approaching its climax; but pressure being very unequal over any extent of area on account of the difference of the heat-radiating capacities of the soil, at the points of maximum pressure a small volume of hot air forces itself into the swift current, and instantly is swept along. This event is noted—above, probably by the formation of a thin streamer of cloud by the condensation of aqueous vapour; below, by a slight puff of wind in the direction of the seat of the momentary disturbance, and therefore in different directions at different localities.

When the sun has reached an altitude of 45°—50° the time has arrived for decisive measures—the rupture and overpowering of the upper current and the escape of the imprisoned air. The equilibrium is at last attained; the overheated air suddenly forces its way at some point through the rapid upper current by means of a sufficiently large vent, but keeps its exit open for a short time only; then it is closed again by the onward pressure. From all sides the confined air streams up into the gap or towards it, but being formed in a moving medium, it is carried along with it bodily, according to the same law that prevented its entrance, viz., its viscosity when in motion. (See fig. 3).

By this forward motion the direction of the air particles, at first perpendicularly upwards towards the point of rupture, attains obliquity before gaining entrance *de facto*, while those that started at the rear become still more slanting in their course, having to hurry forward at an increased rate, but impinging upon those coming from the sides and the opposite direction, are forced out of it, their motion thus becoming sideways, forward, and upward—*i.e.*, spiral. These in front are forced aside by their adhesion and the forward pressure of the up-rushing current, and the inertia of the comparatively unaffected volume of the adjacent air. In this manner the spiral motion is obtained.

The *upward* force of the ascending current is further augmented (and, derivatively, the lateral motion) by the downward pressure of the superincumbent strata of the air, by forcing the lower into the (funnel-like) vortex, which latter assumes the functions of a partial vacuum. The commotion produced in the vortex gradually affecting the adjacent mass of air, the spirally-ascending current assumes naturally in progression the form of a *descending* inverted cone—observed at times in the case of waterspouts, etc.—which finally reaches the surface of the earth, there exerting the *maximum* of force because here the *weight* (gravitation) of the atmosphere, etc., is greatest, and reaches the earth at *a point* from which the action rapidly extends on all sides. The spiral motion is strongest *near* the circumference, while at the centre of the current—the whirlwind—it is directly upwards, but in a more or less oblique direction, on account of the forward motion of the whole and the friction with the surrounding air.

Generally the gyrations of the whirlwind cease as suddenly as they begin—first in the centre, then at the circumference. A dust column, seen at a distance, appears invariably to break off at some distance above the ground, the objects comprising the lower part rapidly descending, while those in the upper portion seem slowly to float upwards, conspicuous articles of small weight being often carried to considerable distances; the light dust preserves its columnar form sometimes for a quarter of an hour or more without apparently changing its place.

In conclusion, the following is a short *resume* of what is intended to be shown in the foregoing, viz :—

1. Whirlwinds are upward currents of heated air, endowed with a spiral motion at the circumference, progressive motion and small diameter in proportion to their height.

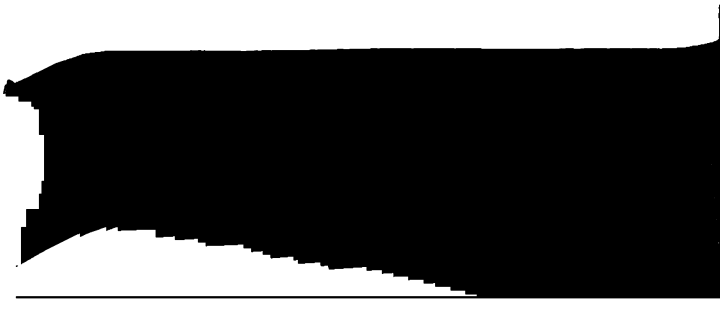
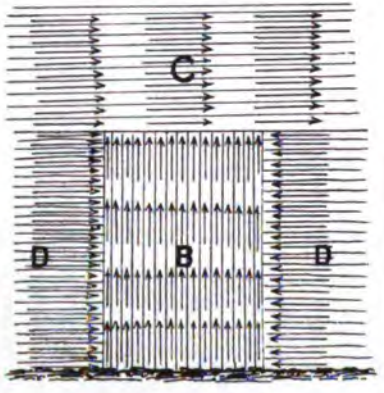


PLATE. III

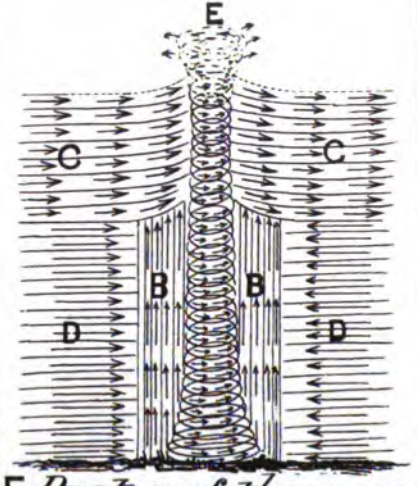
Fig I.



A *Surface of land.*

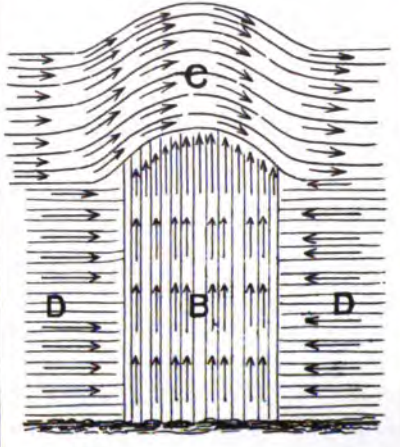
B *Ascending hot air.*

Fig. III.



E *Rupture of the upper current, and air ascending in Spiral motion.*

Fig. II.



C *Upper current.*

D *Surface winds.*

2. They only occur during the warmest part of the year and day, and in calm weather.

3. They are due to the unstable equilibrium of the air, the hot lower portion acquiring a high state of tension by being unable to rise according to the laws of heat, being prevented by some rapidly moving current of cold air.

4. They are produced by the hot air obtaining exit through a narrow vent forced through the upper current.

5. Their locomotion is produced by the vent and its cross air current being carried along with the cold current.

6. Their spiral motion is produced by the shifting of the centre of attraction (the vortex) of the hot air particles and their infringement upon each other, and the unaffected volume of the adjacent air, assisted by friction. In fact they are produced by the same causes, only inversely, as the rotating motions of fluids escaping through a narrow vent below them.

7. They are terminated by the closing of the vent by the onward pressure of the cold current.

8. The retention of light articles in the upper regions (even, perhaps, their ascension) may be greatly facilitated by electricity.

9. Stable equilibrium is produced by the escape of the over-heated air, and its replacement by cold air derived from the upper current or the S.W. surface wind.

ON SOME FOSSIL CORALS FROM ALDINGA.

By the Rev. J. E. Tenison-Woods, F.L.S., F.G.S., &c., Hon. Memb. Adelaide Phil. Society.

[Read September 17, 1878,]

Some corals collected by Professor Tate have been sent to me for examination, and though labouring under considerable disadvantages for the task of their description I have accepted it with much pleasure; not only because these organisms possess more than an ordinary interest for me, but also because they form very good tests, perhaps better than any others of the age and relations of the beds. From the beginning, the corals of our Australian Tertiary formations have received more attention than any other fossils from the same beds. There are few indeed from Victoria or Tasmania that have not been described. There is, therefore, a well-established ground to go upon. I have also recently published in the Proceedings of the Linnean Society of New South Wales for 1877 (vol. 2, p. 292) a list of the extra-tropical corals of Australia. This enables us to compare any new tertiary corals, or the corals of any new beds with the known fauna, so as at once to make very reliable deductions; and thus the relations are, in a manner, of either fossils or formations immediately made known to us. The corals from the Aldinga beds possess a more than usual importance. Very little has been made known of the fossils, and that little excites our interest in a high degree. Professor Tate has made known the existence in its strata of fossil *Belemnites* and *Salenia* and the other organisms are sufficiently different from those of such well-known formations as Mount Gambier, the Murray, and the Muddy Creek to make us wish for more information. The examination of the corals now to be described has not disappointed my anticipations. The forms are for the most part new, and also for the most part so connected with what

has been been already described, that they are seen to belong to one great group. I shall reserve for the end of the paper such remarks on the species as may throw light upon their affinities. I will merely observe now that the most of the specimens were either broken or in such a hard matrix that a full and satisfactory examination is what I could not obtain in every case. The matrix and the preservation shows a remarkable difference from the corals of the various strata of Victoria or Tasmania. There the corals were well preserved, but in a very brittle and soft matrix, so that unless they were very carefully handled they were irrevocably destroyed. A peculiar glazed appearance, which is very common in the fossils of Victoria and Tasmania, is not seen in these; nor do they seem to be stained with ferruginous oxides to the same extent. I mention this because in Victoria and Tasmania the peculiar characters referred to seem to be due in part to the intercalation of volcanic rocks with the formation. It would be worth while to enquire whether such influences had begun when these, perhaps the oldest members of the series, were deposited.

Before I begin the description of the species it may be as well to take a glance at what has been hitherto done in our Tertiary fossil corals, so that the references may help those who wish to follow up the subject.

In 1864 Professor Duncan described some fossil corals sent by me to him. The descriptions and figures appeared in the Annals of Natural History for September of the same year.

In 1865, the same experienced author described in the Annals for September, p. 182, some other corals.

In 1870, he also described in the Journal of the Geological Society, p. 285, a number of new species sent home from the Victorian Geological Survey, and at the same time gave a complete review of all our tertiary species, stating their relations and the evidence they afforded of our climate.

In 1875, he further described in the same Journal, vol. 31, p. 673, some Tasmanian fossil corals, and again in 1876 other species from the same tertiary beds in vol. 32, p. 341.

In 1876 I described two species of fossil corals from Table Cape, Tasmania, in the Proceedings of the Royal Society, Tasmania, p. 115.

In 1877, in the Proceedings of the Royal Society of N. S. Wales, p. 183, I figured and described some new species of corals, and also extended the observations of Prof. Duncan on his and my *Caryophyllia viola*

and *Sphenotrochus excisus*, which I removed into the genus *Deltocyathus*. In this paper I also gave a list of all the Australian Tertiary species, but from which list was inadvertently omitted *Sphenotrochus emarciatus*, *Antillia lens*, Duncan, and *Placotrochus elegans*, nobis.

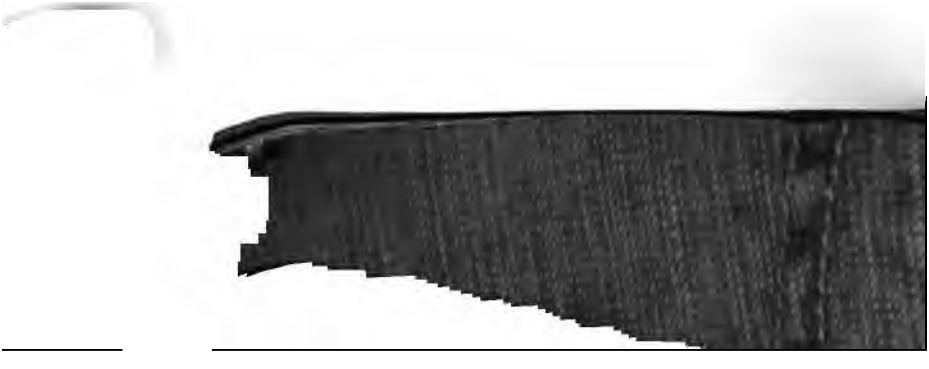
MADEPORARIA APOROSA.

Family Turbinolidæ.—Group Trochocyathaceæ.

Genus Deltocyathus, *M. Edw. and Haime* (1848).

Deltocyathus, M. Edw. and Haime, 1848. *Corallum* simple conical free, no trace of adherence; *calice* nearly circular and shallow; *columella*, ending in a rounded multipartite surface; *septa* straight, large exsert and granular, and the higher orders generally well developed; *pali*, highly developed, unequal, penultimate largest and turned towards antepenultimate so as to form chevrons or deltas; *costæ*, highly developed distinct to the base, with many granulations.

Deltocyathus italicus (*Edw. & Haime*), was formerly the only species of this coral known. Messrs. Edw. and H. separated it from *Stephanophyllia* in which genus it had been placed by Michelin (*Iconographie zoophytologique*, Decrip. of polyp. fossil of France, &c., 1841-1847, p. 32, pl. 8, fig. 3, a young specimen). But *Stephanophyllia* has porous walls, and therefore is very far removed from the family in which the species has to be included. It must, however, be remarked that there are certain pits in the intercostal spaces, which look very much like pores. M. Edwards and Haime describe it thus :— Corallum, a short cone; costæ unequal, formed of a series of very regular globules; columella composed of three bundles of stems disposed in series; four complete cycles; septa very little exsert, thick on the outside; pali very unequal, thick. Professor Duncan is of opinion that the specimens found by Mr. de Pourtales in the Caribbean Sea did not differ much from the Miocene fossils of Europe, or these again from those found at Cape Otway. At least he says that the differences are not greater than are to be found between external divergencies in the fossil forms. The specimens from Aldinga differ very much, first of all in the size. They are longer than any of the dimensions given. They differ again in the shape. Some are perfectly hemispherical, some are truncated cones, and some bell-shaped. But I cannot doubt that I am dealing with a very closely allied species. In one important point it seems to me to differ, and that is that there is no columella. The septa all unite in the centre by numerous processes,



and what seem to be lobes of the columella are in reality the pali of the primaries, which meet in the centre. The same thing occurs in what I call *Deltocyathus viola*, and I must reserve my remarks on the subject for another occasion. I shall therefore name the species and describe it as follows :—

DELTOCYATHUS ALDINGENSIS, n. sp., pl. 1, fig. 1.

Corallum, hemispherical, or in the form of a truncated cone, or bell-shaped, that is to say, hemispherical, with a very thick cylindrical base like a pedicel, no trace of attachment. *Costæ* very distinct and prominent, with numerous small rounded granules, in four cycles corresponding to the septa and continuous with them; primaries and secondaries equal and distinct to the base, where they suddenly thicken; tertiaries thinning out towards the base, and joining the third and fourth orders at about three-fourths from margin, and then making one continuous rib; all very closely covered with numerous small rounded granules. Intercostal spaces about equal in width to costæ and having numerous rounded pits or pores in equi-distant series. *Calice*, circular, either flat or a little convex, from a cauliflower-like mass in the centre arising from the pali. *Septa* in six systems of four cycles, which are not exsert, of equal thickness, very granular, with finely zigzag margins, and continuous with the costæ; primaries straight, free to the centre, where they join rounded cauliflower-like pali; secondaries also straight and free until about two-thirds from the centre, where they are joined by the tertiaries and become much thicker, and here a kind of paliform excrescence projects. The higher orders unite with the tertiaries about a third from the margin. Dimensions—Alt. of the largest specimens 7, diam. 8½ millimetres.

The sides of the septa in a section are seen to be very regularly, closely, and prominently granular. A section at the centre shows that all the septa are united by small processes. When the calicular surface is ground flat, the primaries and secondaries are seen to unite in the centre, and the pali (?) are then seen to be represented by a very slight thickening, nothing in proportion to the foliated appearance of the surface. The junction is not apparent on the natural surface, but the tertiaries seem to send out a transverse thickened process to meet the fourth and fifth orders on each side. It is by a process of this kind that all the septa are joined for they do not in reality curve towards each other.

DELTOCYATHUS TATEANUS, n. sp., pl. 2, fig. 5.

Corallum, very small discoid, flat, thick in proportion to diameter,

base concave, and very slightly smaller than calice. *Costae*, very prominent, continuous with septa, not quite so wide as intercostal spaces, smooth, acute, persistent to the centre of base. *Epitheca*, none. *Calice*, circular. *Fossa*, very shallow, scarcely depressed in the centre. *Systems*, six. *Cycles*, four. *Septa*, not exsert, or only slightly. *Pali*, apparently before secondaries, a chevron-like mass with the ends directed towards tertiary septa. In the specimens the surface is worn, and the pali are indistinguishable from the septa, and it thus appears as if the tertiaries united with the secondaries about a third from centre. There are also tubercles in the centre which seem like pali of primaries. *Wall*, thin, bending outwards to meet costa. Dimensions—Alt., 1½; diam. 3 millim.

Only two specimens, both worn, and one a little broken; the latter the only one in which the pali could be fairly made out. Better specimens may however show that some of my conclusions are subject to modification. It is closely allied to the living *D. rotaeformis*, nobis, but in that species the costae do not correspond with the septa. I have great pleasure in dedicating this species to my friend Prof. Tate, whose zeal and industry in the cause of geology need no encomium from me. It should be noted that the concavity of the base is not seen except in the longer specimen, the other being convex. In the young stages of *Deltocyathus italicus* the base is often rounded, and in form like *Trochocyathus meridionalis*, Duncan; but in all other respects the species seem to be different.

DELTOCYATHUS ALATUS, n. sp., pl. 2, fig. 4.

I am doubtful whether to regard this fossil as only a variety of *D. exoisus*, Duncan. It comes from the Murray cliffs where the latter is not found. Its peculiarities are as follows. The septa are much more spinous in their granules, and they are not so exsert but often deeply lobed. That is to say the kind of lobate teeth and crest at the edge of the primaries and secondaries are distinctly divided and stand out separately. The pali are very solid and distinct. There is no columella, but the septa and pali unite in the centre. The two prolongations of costae at each side of the coral in *D. incisus* become flattened and spread out into aliform appendages in this coral. Not, however, in all cases. There are specimens which approximate closely to *D. incisus*, and there are others where they are much more prominent, and more spread out on the side of the corallum than in the figure given. The granules on the

costae are finer, more numerous, and closer than can be easily expressed on a small sized drawing. On the whole I should not be disposed to regard the species as distinct; but the variation is very important, varying in amount in different specimens. It will be seen that aliform appendages are therefore not of such specific importance as they have been thought to be.

With regard to the genus, I must observe that I do not think the mere deltiform pali a sufficient generic distinction from *Trochocyathus*. But all those species which I have classified as *Deltocyathus* have really no columella. The pali are united to the septa and meet in the middle giving rise to a rather compact tissue in which the component septa are generally distinguishable in this species, but not in *D. viola*. Most of the species may be said to represent *Trochocyathus* in Australia. I think if it be added to *Deltocyathus* that there is no columella, there will be no necessity for creating a new genus. It must be acknowledged that the divisions as they at present stand are not satisfactory. If it were clearly stated that there is no columella because the visceral cavity is empty as in *Desmophyllum*, or that the septa and pali meet in the centre, as in *Conocyathus*, there would be no ambiguity. At present both are described as having no columella.

The fossil at present referred to is common in the Murray River cliffs, four miles south of Morgan. Dimensions, about the same as *D. excisus*.

It is remarkable that though *D. excisus* is very common at Muddy Creek, I have never seen a specimen with any form of base except two small basal prolongations, though this form is the exception at the Murray beds. The deeply lobed septa are rarely seen in the Muddy Creek specimens.

The next species is a *Trochocyathus*, of which we have already two fossils described and two doubtfully from New Zealand. In this genus the fossils extend from the present day to the Lias.

TROCHOCYATHUS HETEROCOSTATUS, n. sp., pl. 2, fig. 1.

Corallum short, broadly wedge-shaped, with a very conspicuous oval, slightly convex, radiately ribbed, basilar scar, which has a neat, somewhat prominent, clearly defined margin; base proportioned to calice as five to eight. *Calice*, elliptical, shallow ends of major axis slightly lower than those minor. *Costae*, distinct, granular, with fine granules, and disposed in four cycles, but in a very singular and exceptional manner.

Those corresponding to the fourth and fifth orders of equal width, and continuous from margin to base. First, second, and third orders broader and more exsert at the summit, but thinning out rapidly to a fine point, and terminating at about a fourth from the base, except the primaries at the ends of the major axis which are continuous to the base. *Septa*, exsert proportionately to the orders in six systems of four cycles. Primaries somewhat high, rounded, narrow, or not projecting much into the fossa. Secondaries apparently only half their height, but all are broken in the only specimen I have seen. Third order a little thinner, but apparently as high. Fourth and fifth orders nearly as thick at the margin, but only very slightly projecting into the fossa as a thin edge; all highly granular and continuous with the costae. Granules disposed in ridges at the edge of the primaries. Pali small, styliform processes before all the cycles except the last. Columella uncertain, as it was partly covered with hard matrix, which could not be removed without destroying the septa. Dimensions—Alt. 4, major axis $4\frac{1}{2}$, $3\frac{1}{2}$.

Family Oculinidæ.

In the third principal group of the *Madreporaria aporosa* we have the family of the *Oculinidæ*, that is to say, branched corals with lateral buds with a great deal of very compact ivory like tissue. We have two species of this family in the collection—one with alternate calices and a peculiar structure which affords evidence of importance, as I shall notice presently. It belongs to the genus

Amphihelia—(*Edwards and Haime*).

which is erected for dendroid corals with alternate buds. The cœnenchyma is highly developed, especially at the base. The costae are only faintly marked. The columella is rudimentary, or absent, and there are no pali. The septa are few, entire, and not exsert. There are two species living—one in Australia and the other in the Mediterranean. One has been found fossil in our tertiary rocks. This is A. *incrustans* (Duncan), a very abnormal form.

Amphihelia striata, n. sp., pl. 1, fig. 4.

Corallum of irregular, short, cylindrical branches; calices circular, scattered, the lower ones sunken, the terminal ones very much exsert, all alternate, very deep and narrowing towards the base. No columella, but filling up from below in an open kind of spongy tissue arising from the coalescence of the septa. In the terminal calices the septa are exsert and salient, in the lower ones they are quite inconspicuous, in six

systems of three cycles, which are unequal according to the orders, a little thick but conspicuously swollen and rounded at the extra-mural part. The costae are conspicuous on the edge of the young calices, but the whole corallum is covered with a thick compact outer layer or sheathing tissue, which is covered with fine anastomosing grooves. On one branch these grooves form circles like tattooing; underneath this the costae seem to be very continuous, and each is covered with a linear series of small granules. In most of the broken fragments the outer sheath can be seen plainly.

This species comes very near *A. venusta*, E. and H., but the peculiar striations on the outer sheath, and the costae distinguishes it sufficiently. Some of the calices fill up from below by a kind of spongy tissue which results apparently from a union of the septa; others are quite empty to the base to which the calice narrows in a curved line, the point being only separated by a very thin wall from the curved upper portion of the alternate calice below. This is a variation in the structure which affects Prof. Duncan's reasons for transferring *Amphihelia* to the Turbinolidæ. It is not confined to the young branches, but is seen in the oldest portions of the corallum and in calices adjoining one another.

AMPHIHELIA ZICZAC, n.sp., pl. 2, fig. 2.

In the species which I am about to describe there are peculiarities which I think should place it almost in a genus apart. There is an axis into which the calices are sunk, and then outside this, but separated by hollow spaces, there is an outer sheath of some thickness. These hollow spaces seem to have no communication with the visceral cavities. It seems like an outer covering of dermic tissue, which was secreted over the basal structure while the lower cells were alive, leaving large apertures for them. As far as can be seen also, the septa are represented only by merely raised rounded lines on the upper part of the calice, and though they are never conspicuous in the genus, yet here they can scarcely be seen except at the bottom of the visceral chamber where they are confluent. The following is the diagnosis:—

Corallum in zigzac branches of various thickness, the longer or probably basilar ones having an outer sheath with interstices, which do not communicate with the visceral cavities. *Calices* at every angle, projecting, alternate, numerous, and at equal short distances. *Septa* only salient at the bottom of the calices, and represented by rounded lines at the upper part, and not visible at all at the margin, in three cycles; the two first equal, and confluent at the base, but no calice was preserved

entire, and it could not be said whether the third order was present in all the systems or not. *Costae*, none visible; but the surface is covered with fine grooves which divide it into small polygonal spaces on which there are faint granulations, but the whole structure is so much worn that this appearance is exceedingly difficult to make out. Dimensions:—Length of the branches from ·25 to ·37; diameter, from ·3½ to ·7; distance between the calices on the same side 8 millimeters.

Family Astræidæ—Group Trochosmiliaceæ.

Genus Conosmilia (*Duncan*), 1865.

In the descriptions of new corals from Australia, published by Prof. Duncan in the "Annals of Natural History for 1865," (p. 182), a new genus was erected for simple pedicellate corals with a twisted laminated columella and scanty endotheca. This was *Conosmilia*. I have given a synopsis of the genus in the "Proceedings of the Royal Society of N. S. Wales" for last year. I think the general character of these fossils may become the type of a family, as there are other anomalous genera to be noticed presently. In the collection there is one species of what I believe to be this genus; but it is a deformed specimen, and therefore any attempt to determine the details would be hazardous. I shall merely give it a name and some of its leading features, and leave the rest until better specimens are found.

Conosmilia contorta, n. sp., pl. 1, fig. 3.

Corallum, very much twisted and distorted, but normally a very elongated one, cylindrical or slightly elliptical. *Costae*, broad, flat, or in places acute, smooth or indistinctly vermiculate, corresponding with septa. *Epitheca*, thin, smooth, somewhat shining, in concentric folds occasionally. *Septa*, not granular, not exsert, but projecting in rounded edges more or less according to the orders. Systems, six. *Cycles*, four. *Fossa*, rather deep. *Columella*? *Endotheca*, scanty. Long. 20 lat. of calice, 8. One specimen with doubtful fragments of two others.

In the new species I am about to describe we have *Conosmilia* without a columella, but with pali. In every other respect it resembles the above-named genus of fossils, which Professor Duncan was the first to describe. The absence of a columella or the presence of pali has always been regarded as of generic importance in the present classification. I therefore propose a new genus for these corals, which I shall name *Cyathosmilia*. There is considerable analogy between this genus and *Cono-*

cyathus of the Trochosmiliacese. They may be regarded as Conosmilse with pali and without a columella, or Conocyathese with endotheca and without the peculiar cyclocostal arrangement which is so thoroughly *Turbinolian* in its character.

CYATHOSMILIA (new genus).

Simple pedicellate corals with endotheca and pali. No columella.

CYATHOSMILIA LATICOSTATA n. sp., pl. 1, fig. 2.

Corallum small, curved, slightly compressed in the direction of the curve, tapering towards the pedicel, which is very small and concave, bearing a crest at the outer edge of the curve, which is composed of irregular projections. *Costæ*, simple, broad, raised, rounded, separated by very narrow grooves (which correspond with the tertiary septa, while the costæ correspond with the primaries and secondaries), terminating in regular angular points at the edge of the calice, giving it a coronate appearance. *Epitheca*, conspicuous in concentric folds of irregular width, and undulating over the costa. *Calice*, broadly elliptical. *Fossa*, shallow, in fact only the slightest depression is perceptible. *Systems:* six, with three cycles. *Septa*, not exsert, granular, primaries and secondaries equal, thick, wedge-shaped; tertiaries thin, small, inconspicuous. *Pali*, before primaries and secondaries only, thinner than septa, slightly exsert, primaries only half the size of secondaries. *Endotheca* filling up space between pali, septa, and fossa, and rather numerous; stages very rare between septa, except at the base. *Wall*, thin, dotted with deep pits, or pairs of pores, on opposite sides of the septa. These are not visible except in worn specimens where the epitheca is absent; otherwise it covers them. *Dimensions*—Alt. 6 to 11, major axis 2½ to 5, minor 2 to 4.

Aldinga, about a dozen specimens, but very few complete. In all the larger ones the broken ends of the septa are very distinctly seen to be composed of two thick laminæ pressed together. In these specimens also the intercostal space is flat, wide, and shallow. The centre corresponds to the tertiary septa, and has pores on each side which are distinct, regular, and apparently deep. There were fragments of corals collected which, if perfect, would have been twice the dimensions given.

CYATHOSMILIA ? TENUICOSTATA n. sp., pl. 2., fig. 3.

I give this name to a single specimen of a conical corallum with a rather broad, blunt, cylindrical pedicel, which is granular, and does not seem to have been adherent. *Costæ* corresponding with septa, granular

above, vermiculate below, equal in size and separated by rather broad, flat intercostal spaces. *Epitheca* pellicular, smooth, shining. *Septa* very much thickened at calicular margin exsert, closely and thickly granular. Systems six, cycles four, the fourth rudimentary, though its corresponding septa do not differ from the others. Primaries very thick; secondaries smaller; tertiaries rather thick, but not reaching more than half way to the centre. *Pali* high, broad, and granular; probably before all except the last; yet this is uncertain, as the coral is broken. *Columella?* *Calice* broadly elliptical, not deep. Dimensions—alt. 5, maj. diam. 6, min. 4½. One broken specimen, in which the endotheca could not be well made out; but its general habit and appearance induces me to refer it to the *Astreidæ* rather than *Trochocyathus*, to which genus it would belong if there were no transverse interseptal dissepiments.

The next fossil in the collection has remarkable affinities and relations. It is a *Conosmilia* without an epitheca and simple granular costæ, but with a very remarkable columella, which terminates in two conspicuous round tubercles. This distinction is of generic value, and I propose a new genus for its reception. In reference to the peculiar columella, I shall designate it by the name of *Bistylia*.

BISTYLIA (new genus).

Simple corals, without epitheca, and a bistyliform columella.

There are two divisions in the Trochosmiliacese—(1) without any epitheca; (2) with epitheca. This genus belongs to the first, and is associated with *Lophosmilia*, *Parasmilia*, *Coelosmilia*, having, like all these, scanty endotheca. The first-named, however, has a lamellar columella, the second a spongy one, and the third none. All three are upper mesozoic fossils, with one living *Coelosmilia*. *Axosmilia* is one of the Trochosmiliacese, with a styliform columella, but it has a distinct epitheca.

BISTYLIA ADHERENS, n. sp., pl. 1, fig. 5.

Corallum small, more or less contorted, nearly always adhering by a large portion of its side, cylindrical, suddenly contracting to a point. *Costæ* small, rounded, granular, continuous, corresponding with septa, and alternating in size with them, broader than intercostal spaces, which have numerous concentric folds, probably the former margins of the corallum. *Calice* circular, generally a little contracted or bending in. *Systems*, six. *Cycles*, three. *Septa* slightly exsert; rather thick, granular, primaries largest, secondaries a trifle smaller, tertiaries half the size,

edges rounded or rendered sinuous by the granules. *Fossæ*, moderately deep. *Columella*, two small rounded tubercles. Dimensions—Alt. from 4 to 8; diam., 2½ to 3 millim. Six specimens, the most of which had on one side a calcareous cast of the shell to which they adhered, which was a small bivalve apparently.

FAMILY ASTRÆIDÆ.—GROUP CLADOCORACEÆ.

This division is distinguished by the budding which is lateral, and which remains always with its individuals more or less free forming tufts, but never giving rise to a massive corallum. The first genus is *Cladocora*, containing slenderly branching ramose corals, and which according to Professor Verrill is closely related in its polyps to the *Astrangiacea*. The corallites in this genus are cylindrical, very long, erect, and free laterally. They have an incomplete *epitheca*, which often unites one individual to another. The calices are circular and shallow. *Columella* papillary. There are six unequal systems all exsert, rounded, and finely toothed at their edges. *Pali* before all the *septa* except the last. *Wall* compact, moderately thick, and furnished with simple costa, which are granular, hispid, and straight.

The fossil figured is an interesting specimen of the genus, one not far removed from the well-known *Cladocora cespitosa* (Gualtieri), which is common in the Mediterranean Sea. Unfortunately the specimen is worn and broken so that the details cannot be made out satisfactorily. There are no perfect calices, and the branches are a good deal waterworn. I have very little doubt, however, that the species is new. It is thus described:—

CLADOCORA CONTORTILIS, n. sp., pl. 1, fig. 6.

Corallum, a very compact tuft of corallites of different dimensions turning around one another. *Branches* irregular, cylindrical, conical, or of equal thickness throughout, occurring at short distances and twisting round to coalesce with others and form a thick, matted, stony mass. *Epitheca* not visible. *Costæ* numerous, narrow, angular at the edges, granular and straight. *Septa* not easily made out, but apparently three thin cycles, some uniting or bending towards the others, and all apparently meeting the pali in the centre. *Wall* rather thick. *Endotheca* somewhat abundant, and, as well as I can judge, rather more abundant than is usual in the genus. *Dimensions*—Alt. 35, diam. of largest branches, 5; of the smaller ones, from 2, 2½ and 3 mil. The fossil appears to me to be very distinct from all existing or fossil species. In the bent and twisted form of the branches it may come nearest to *C. stellaris* (Edw. & H).

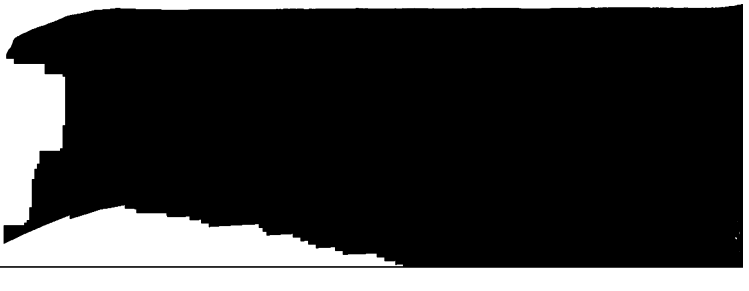
FAMILY ASTRÆIDÆ—GROUP ASTRÆACEÆ.

A very interesting, but very imperfect fossil form of *Plesiastræa*, is amongst the collection. The genus belongs to the *Astræaceæ* or corals which have a massive structure, the individuals being intimately united, but multiplying by budding. The main distinguishing feature of *Plesiastræa* is the possession of conspicuous pali, which, indeed, separates the genus clearly from every other species in the group. There are at most only eight species known, two of which are Australian, and one fossil. Three belong to the Pacific. In the species under consideration I am unable to speak very positively as to its character as the fragment is small and very much worn, in fact there is not a single perfect calice in the specimen. It has a very strong resemblance to *Plesiastræa Urvillei* in this that the calices are of equal size, and often oblong, in which respects it differs from *P. Peronii*, the form common on our coasts. Owing to the very complete details given by Messrs. Edwards and Haime in their diagnosis of the internal structure of *P. Urvillei*, which is living at King George's Sound, I am able to say that the fossil is new.

PLESIASTRÆA ST. VINCENTI, n. sp.

Corallum flat. *Calices* very slightly salient, very close, but with distinct borders, circular or compressed. *Costæ*, continuous with the septa, and projecting so as to unite at times with the contiguous ones of the next calice, prominent above the margin. *Systems*, six; *Cycles*, four; but the forth absent from some systems; primaries, secondaries, and tertiaries nearly equal, and extending to the pali, which are so worn that it would be hazardous to attempt details, except that they seem large. The edges of the septa seem to be dentate, much in the way that is figured in the "Annals des Sciences Nat.," (vol. x., plate 9, fig 2a), and the columella appears to be a few papillæ. In a vertical section the exothecal traverses are seen to be abundant, horizontal, and at irregular distances, but there are about 20 in 10 millimetres. The endothecal traverses are extremely irregular, thinner, sloping upwards at every angle, and giving rise to a cellular tissue. In both these particulars it differs remarkably from *P. Urvillei*. Diameter of calices, 3 rarely 4 millim.

Note.—This coral which was first brought to my notice by my pupil, Mr. Stirling Smeaton, occurs in large hemispherical, or flattish rounded masses; an imperfect lump measures seven inches in diameter, and from two to three inches in thickness. Locality—Hallett's Cove, St. Vincent's Gulf *(R. Tate)*.



Summary.—The general facies of these interesting corals is that of the Australian tertiary beds, as far as we are acquainted with them. None of the species are however known. Some of the genera have been found in other beds. These are—*Deltocyathus*, *Trochocyathus*, *Amphihelia*, and, doubtfully, *Conosmilia*. Our *Deltocyathus*, as already observed, is closely allied to, if not identical with, *D. italicus*. That species is common in the Cape Otway beds in Victoria, and is living in the West Indian Seas. It will require a careful comparison to determine if our fossil is the same. It is very abundant apparently at Aldinga. We have two species of *Trochocyathus* already described. Both are very distinct from the Aldinga species, which is much smaller, and has a well-marked basilar scar. We have one of the species living in the Port Jackson. Professor Duncan thinks that the genus can hardly be separated from *Deltocyathus*; but if my remarks on the absence of a true columella are found to hold good for all the species, the distinction is a justifiable one. *D. Tateanus* comes near to an existing form. The flattened character may, however, vary, as we see that in the case of *D. Aldingensis* these are features which vary much at different ages and for different individuals. In *Amphihelia striata* and *A. ziczac* we have two forms of *Oculinidæ*, which are of great interest. They are both closely related to our existing Australian *A. venusta*, but are very different from our tertiary fossil form, *A. incrustans*, which I venture to suggest would perhaps have been better placed in a genus by itself. Both the Aldinga fossils in their structure throw a remarkable light upon the mode of growth of these corals. We see not only that the calices fill up from below in some instances, but not at all in others, a circumstance clearly dependent upon the exigencies of the animal, or perhaps upon its size. This gives us a glimpse of the very artificial manner in which our great divisions of the *Madreporaria* are classified, and makes us fear that as the habits and economy of the animals and their stony dwellings are studied the whole arrangement will have to be remodelled. *Amphihelia* did not, as far as we know, make its appearance until the tertiary period. The *Oculinidæ* generally are entirely a recent family, extending to the Mesozoic rocks, but only four genera are found in them, and only two below the chalk. The only fossil species of *Amphihelia* known are those from Australia.

I have already observed the position that the new genera of *Trochosmiliaceæ* take in the classification. They are a series of simple corals with scanty endotheca, in which respect they are related to Upper Meso-

zoic forms rather than to any other. But our Australian corals are a group in themselves, with really no very strong affinities with any hitherto described. None of those have pali; some have an epitheca, and others are destitute of it, but the fossils amongst our Australian group which have any of these features are sure to differ in every other respect in a remarkable degree from them. It is, as I have already remarked, this natural extension that we might expect to which our systems of classification will have to submit, as our knowledge of the variation of the plan of nature becomes wider. It is on this account that we cannot form any conclusions, or at least any safe conclusions, as to the age of our beds from paleontological considerations alone. The resemblances to the fossils of tertiary ages in the northern hemisphere are few and of a trifling kind, while the differences are very numerous and wide. We are baffled by the difficulty of comparing things which have little or nothing in common. But while this is true, we may institute comparisons upon paleontological grounds alone between our various Australian deposits. Thus, this group of *Trochosmiliacea* shows us that the Aldinga formation has fossils which intimately connect it with the Australian group of tertiary rocks. No species can be identified with those already described, though one, *Conosmilia contorta*, may be only a variety. *Cyathosmilia* is a kindred genus with pali. *Bistylia* is a little more divergent, for it has distinct costa like *Parasmilia*, but with a bistyliform columella.

Plesiastræa is entirely a recent form, and we may say Australian as well, for the species described which are not Australian are either from the Pacific or Indian ocean. There is one fossil species known in the Belgian miocene. The fossil species here described is very close to our living form, now common on the same parts of the coast.

Though no existing species has been yet found, and though the genera even are, as far as we know, for the most part extinct, yet I think we are justified in calling the coral fauna an Australian Tertiary one — the forms of life approximate to a Mesozoic character, in my opinion, though I form it upon slight grounds, and I should say that we have one of our oldest tertiary fauna represented. The corals are partially such as would grow in a deep sea at the present time, but *Cladocora Plesiastræa* are merely litoral species, and probably also *Amphihelia*. There are no reef-building forms amongst them, for though the three last named are branched corals, yet they never grow to any size beyond insignificant tufts. They do not evidence a climate different from the present climate of South Australia, that is if the animals were subject

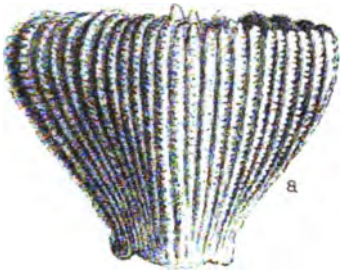
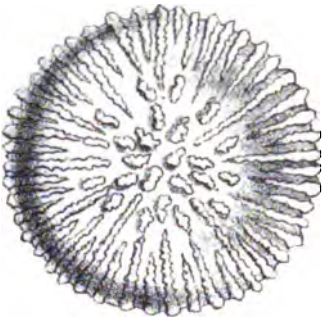
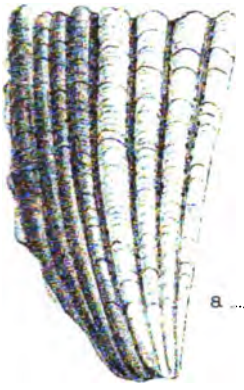
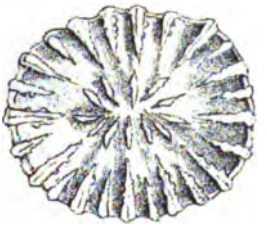


Fig. 1.







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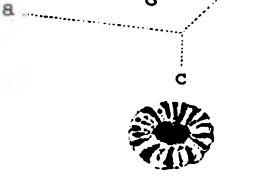

Fig. 3

Fig 5.b

Fig. 6.

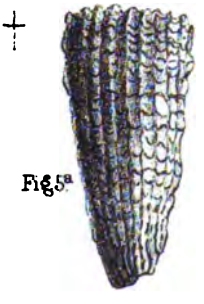

Fig 5.a

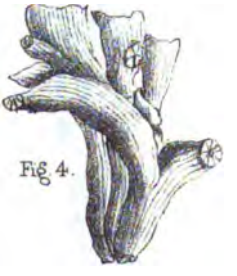

Fig. 4.

m. Woods, Delt.

S.T. Leigh & Co Lith. Pitt St. Sydney

Fig. 1. Deltocyathus aldingensis
- a. Coral. b. Calice.

Fig. 2. Cyathosmilia lateicostata
- a. Coral. b. Calice c. Section

Fig 3. Conosmilia contorta.

Fig. 4. Amphihelia striata

Fig. 5. Bistylia adherens.
- a. Coral b. Calice.

Fig. 6. Cladocora contortilis.

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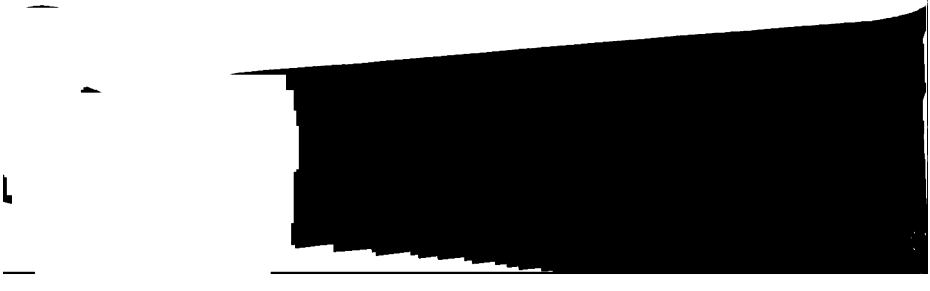


Fig.1a

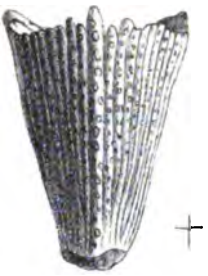
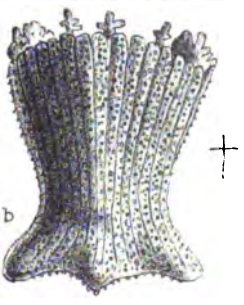


Fig.1b

Fig.3.

Fig.2.



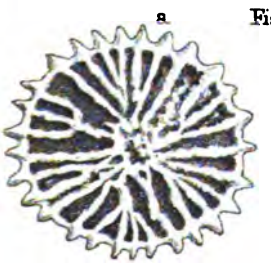


Fig.5.

Fig.4.c

m. Woods, Delt.

S. T. Leigh & Co Lith. Pitt St. Sydney.

Fig.1. Trochocyathus heterocostatus
" b. end View.
Fig.2. Amphihelia zicgac branch & Section
Fig.3. Cyathosmilia tenuicostata
a. Coral. b. Section.

Fig.4. Deltocyathus alatus.
" a. Calice. b. Coral.
Fig.4c Deltocyathus alatus, (end View).
Fig.5. Deltocyathus tateana.
" a. Calice. b. basc

to such conditions of life as kindred animals would be now; but I think we should be cautious in forming any positive conclusions on this subject, as the most of the animals are so different from any we know. Besides, each species is subject to its own condition of life. Thus, I have found lately that a Millepora coral exists extensively on the extreme South of New Zealand. This is the only species known to me outside the tropics. If the species were found fossil, we should certainly say that it gave evidence in favour of a warm climate. Cumulative evidence from the whole forms of life are the only safe grounds on which climatical conclusions can be formed.

EXPLANATION OF PLATES.

Plate I.

Fig. 1. *Deltocyathus Aldingensis*, a. coral, b. calice, both much enlarged.

Fig. 2. *Cyathosmilia laticostata*, a. coral, b. calice, much enlarged, c. section slightly enlarged to show the double septa.

Fig. 3. *Conosmilia contorta*, nat. size.

Fig. 4. *Amphihelia striata*, nat. size.

Fig. 5. *Bistylia adherens*, a. coral, b. calice, both enlarged.

Fig. 6. *Cladocora contortilis*, nat. size.

Plate II.

Fig. 1. *Trochocyathus heterocostatus*, a. coral, b., end view of calice showing primary costæ; both much enlarged.

Fig. 2. *Amphihelia zicsac*, a. branch, b., another partly ground down to show secondary layer of dermic tissue.

Fig. 3. *Cyathosmilia tenuicostata*, a. coral, b. section.

Fig. 4. *Deltocyathus alatus*, a. calice, b. coral.

Fig. 5. *Deltocyathus Tatcanus*, a. calice, b. base, both much enlarged.

NOTES ON THE CORRELATION OF THE CORAL-BEARING STRATA OF SOUTH AUSTRALIA, WITH A LIST OF FOSSIL CORALS OCCURRING IN THE COLONY.

By Prof. Ralph Tate, Assoc. Linn. Soc., F.G.S., &c.

[Read September 17, 1878.]

The Tertiary Corals of Australia have been perseveringly and critically studied by Dr. Duncan and the Rev. J. E. Tenison Woods, and to them alone are we indebted for our knowledge of the no less than 42 species which are recorded by the latter author ("On Some Australian Tertiary Corals;" Trans. Royal Society of New South Wales, 1878) as constituting the coral fauna of Australian Tertiary times.

All the species hitherto known are derived from the Miocene (or Eocene) rocks of Western and Southern Victoria and Tasmania; not one being known from the equivalent strata in South Australia. In Dr. Duncan's paper some species are stated to have come from Mount Gambier; but Mr. Woods, who collected and forwarded the specimens, states that this was not the case, but that they were from the Tertiary beds of Muddy Creek, in Western Victoria. Dr. Duncan regards, moreover, South Australia as comprising the whole of that geographical division of the Continent of which Victoria forms a part; and consequently many of the Victorian corals have had incorrectly given to them a South Australian habitat.

In the foregoing paper twelve species new to science are established, all of which are from this province. These additions to the Tertiary coral fauna of Australia bring up the total to fifty-four. As other species occur with us, I thought this an opportune occasion to lay before you the results of my determinations in the form of a catalogue, and also to submit a summary of my observations on the geological strata from which the corals have been obtained.

Our tertiary strata, though very fossilferous are not generally in that state conducive to the preservation of their organic contents. Casts

of corals are not rare in the limestones and calciferous sandstones of the River Murray cliffs, at Mount Gambier, at Adelaide, and elsewhere. But certain beds forming part of the sea cliffs of Aldinga Bay, St. Vincent's Gulf, and at a few very circumscribed spots on the River Murray, contain corals as well as other forms of life in a good state of preservation. From these I have gathered 21 species, 7 from the Murray cliffs and 14 from the Aldinga series of beds.

The palæontological differences between the highly fossiliferous portion of the Murray beds and that of the Aldinga rocks, so strongly marked in the case of the corals, has for some time past been regarded by me as indicative of a difference of age, the older series being the latter; and not due to difference of habitat. I do not intend on this occasion to substantiate this statement, but will content myself by pointing out the relative positions of our coral bearing strata.

A generalized section of the strata of the River Murray cliffs is as follows :—

1.—Lacustrine (?) sand and marls. No fossils, exceeding 60 feet in thickness.

2. Upper Marine Series; shelly limestones (false bedded) and oyster beds, with occasional argillaceous and sandy bands. Rich in gasteropods and corals. About 50 feet thick.

3. Middle Marine Series; usually a yellow calciferous sandstone; 40-45 feet thick. Rich in echinoderms, brachiopods, pectens, and polyzoa.

4. Lower Marine Series.—Ferruginous sandstones and polyzoan limestones. Rich in echinoderms and brachiopods, but for the most part of different species to those in the upper beds.

The Upper Marine Series is the direct equivalent to the Muddy Creek beds, which are variously referred by the Victorian geologists to the Upper Eocene, Oligocene, and Lower Miocene, and which Mr. Selwyn (Quart. Journ. Geol. Soc, vol. xvi., p. 147, 1859) considers to be the oldest tertiary deposits in Victoria.

The Aldinga section admits of division into—

1. Lacustrine (?) clays. No fossils; 48 feet.

2. Upper Series.—Calciferous sandstones and impure limestones, with oyster banks; 22 feet.

3. Lower Series, consisting of beds of a most diversified character—clays, limestones, and sands rapidly replacing one another in horizontal and vertical extension; not less than 80 feet. Corals occur in the clays and limestones.

Sections after this character appear in a length of coast-line of about 20 miles, extending from Hallett's Cove on the north to the south side of Aldinga Bay. The upper Aldinga series I place on the same horizon as the upper series of the Murray cliffs; and the lower Aldinga beds I regard as equivalent in part to the middle and lower Murray series, but on the whole inferior to them. The coral bed at Hallett's Cove is probably coterminous with the upper series of the Aldinga section.

The following list includes all known South Australian corals, corrected in accordance with the Rev. J. E. Tenison Woods's Paper "On Some Australian Tertiary Corals" (Trans. Roy. Soc., N.S.W., 1878):—

LOWER ALDINGA SERIES.

1. Trochocyathus heterocostatus (*T. Woods*). Clays at Blanche Point.
2. Deltocyathus Tateanus (*T. Woods*) " " "
3. " Aldingensis (*T. Woods*) " " "
4. Cyathosmilia latitcostata (*T. Woods*) " " "
5. " tenuicostata (*T. Woods*) " " "
6. Bistylia adherens (*T. Woods*) " " "
7. Conosmilia contorta (*T. Woods*) " " "
8. Flabellum distinctum (*Ed. and Haime*) " " "
   also in limestone at Port Vincent, Yorke's Peninsula. It is fossil at Cape Otway, Victoria, and is living in the Red and and Japan Seas, and off the north-east coast of Australia.
9. Amphihelia striata (*T. Woods*). Limestone bands in clays at Blanche Point, Aldinga Bay.
10. " zic-zac (*T. Woods*). Glauconitic limestones, north of Blanche Point.
11. Cladocora contortilis (*T. Woods*). Calciferous sandstones, in which the fossils are silicified, south side of the mouth of the River Onkaparinga.

UPPER ALDINGA SERIES.

12. Plesiastræa St. Vincenti (*T. Woods*). In a conglomerate bed, Hallett's Cove, St. Vincent's Gulf, 12 miles south from Adelaide.
13. Plesiastræa sp., Hallett's Cove.
14. Conotrochus typus (*Sequenza ?*), Hallett's Cove.

Upper Murravian Series.

15. Sphenotrochus Australis (*Duncan*). River Murray Cliffs; and Muddy Creek.
16. Flabellum Victoriæ (*Duncan*). River Murray Cliffs, and well-sinking, 21 mile camp north from North-West Bend; also, at Muddy Creek.
17. Placotrochus deltoideus (*Duncan*). Very common. River Murray cliffs, and '21 mile camp.' Occurs at Muddy Creek, Hamilton, Victoria, and Table Cape, Tasmania.
18. Antillia lens (*Duncan*). River Murray Cliffs, and Muddy Creek.
19. Balanophyllia Australiensis (*Duncan*), River Murray Cliffs, and '21 mile camp;' also Muddy Creek.
20. Deltocyathus viola (*Duncan*). River Murray Cliffs, five miles south from Nor'-West Bend; also Muddy Creek.
21. " alatus (*T. Woods*). R Murray Cliffs.

SUBTERRANEAN DRAINAGE IN THE INTERIOR.

By T. E. Rawlinson, C.E.

Communicated by C. Todd, C.M.G. · [Read September 17, 1878.]

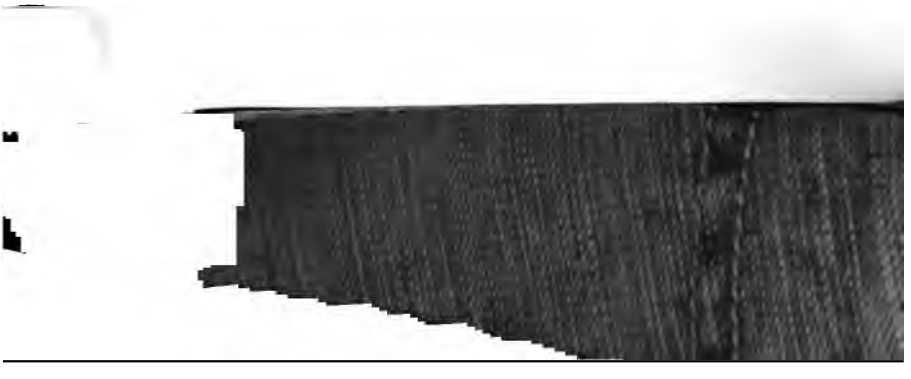
[Abridged.]

The author states the object of his Paper to be to enquire into the cause of the disappearance of the vast bodies of river water which collect on the inner watershed of the bordering coast ranges of Australia, and considers this can only be accounted for by their absorption into porous beds of sand, gravel, &c., under the tertiaries occupying the interior basin of the Continent.

To facilitate such enquiry, the author suggests that the Philosophical Society should collect geological data supplied by the sinking of wells and dams in various parts of the country. He then notes the following facts :—

The Murray River, before receiving the Ovens, flows with a volume of 2,660¾ cubic feet per minute. The Ovens River contributes 596½ cubic feet per minute, but with this addition the volume of the water of the River Murray, below the junction with the Ovens, is only 2,975 cubic feet, instead of 3,260¼ cubic feet, which is the amount of the Murray with the volume of the Ovens River added, but, further down the River Murray is diminished to 2,411 cubic feet, just before it receives the River Goulburn. Now here is a distinct loss of 850 cubic feet of water per minute in a course of a few miles.

The rivers of the north watershed of Victoria, such as the Loddon, Campaspe, Avon, Avoca, Richardson, and Wimmera, which yield vast quantities of water in the wet season, and near their sources are perennial streams, fail to have a volume at all in the lower part of their course as they approach their outlet in the River Murray during the summer season.



The northern watershed of Victoria, during the year, from only a portion of its area (about two-thirds), yields between two to two and a half millions of cubic yards of water, of which one million is available for conservation and use if suitable works are undertaken for that purpose; but at present the large proportion of these waters are wasted in flooding adjacent lands in temporary floodings of the River Murray, and a large proportion is unaccounted for.

In addition to the watershed of Victoria above referred to, we have the vast area of New South Wales, Queensland, and South Australia, from or into which flow the Murrumbidgee, the Lachlan, and the Darling as feeders of the River Murray; the Barcoo, Cooper's Creek, and other large streams which empty themselves at nowhere in particular in the interior, and yet in some seasons convey vast volumes of water down their channels.

It has been hitherto a most convenient explanation of the phenomenon of the disappearance of these large volumes of water that they are evaporated, and in the case of the River Murray and its tributaries that they pass away to the sea; but neither of these causes is sufficient to produce the results alleged. It is true that on the level plains of the interior evaporation may be a very large element of dissipation of the rainfall; but it does not apply in the same manner to the mountain ranges, where the great bulk of the water falls, and even on the plains evaporation can only take place when there is moisture to be acted upon, consequently during long droughts radiation of heat from the ground may be excessive; but it abstracts no moisture from that which has already been dessicated, and when heavy rains do fall the ground is rapidly cooled, radiation and its consequent influence in evaporation is checked, and much of the water passes into the ground or away to the natural drainage channels, and on the ceasing of the rain and the return of clear cloudless sky, there is a reduced area over which evaporation can take place. I have more particulary noted these matters owing to the persistence with which the disappearance of our interior river waters have been attributed to evaporation. This last is a large and important item for consideration in all questions of Hydrography in Australia; but it is only one, and does not account fully for all the observed phenomena.

The example I have given of the River Murray is a good illustration of the position which I have assumed, namely, that evaporation and sea outlets are but element, but do not embrace the whole. Here we have a

river having a volume of 2,663¾ cub. ft. receiving another river having a volume of 596¼ cub. ft., and yet about 50 miles lower down in its course its volume is only 2,411 cub. ft., being 850 cubic feet less than it was above. It needs no very profound reasoning to arrive at the conclusion that such a sensible loss (rather more than one-fourth of the gross volume) cannot be accounted for by the ordinary process of soakage or evaporation; and the inference to be drawn is exceedingly strong that there exists natural features, which favour the theory that the waters seek an underground absorbent or outlet for the missing volume. It is no strange thing in Australia that in certain places, where beds of limestone exist, there are caverns and subterraneous watercourses, but, singular as these appear, and real in fact, they do not satisfy the question of what becomes of the rain which annually falls on the inland slopes of this Continent, the large portion of which does not reach the ocean by ordinary river channels.

The knowledge that so large a part of the interior of Australia is tertiary, resting at its edges on older strata, except in one instance where it touches the Southern Ocean, gives some clue to the formation of a theory which may account for the disappearance of the waters, and, I believe, will ultimately be proved to be the storage reservoir where is conserved the rain and river waters which other theories fail to account for. There is one thing certain, which, if it be granted, that vast volumes of water disappear from our river systems they cannot pass to the sea by way of Victoria, New South Wales, Queensland, the Northern Territory. or Western Australia, owing to the land being edged round with primative impervious rocks, and the possibility of escape at the only visible outlet—namely, the south-east part of South Australia is very improbable owing to the want of all evidence of such outflow in the Southern Ocean, which skirts our shores.

Consequent on the deductions made from the above line of reasoning and known facts, I feel confident that in and below our central tertiaries there exists abundant supplies of water if sought for with a reasonable degree of care and skill.

It is quite possible that there may be one or two mistakes or failures at the outset, but that should not deter us from following up the question to a successful issue. And once establish the existence of these water supplies in unlimited quantities at reasonable cost the future of this country is assured as one that must take the lead in wealth and prosperity, and possibly the central state of a federated Australia.

LIST OF MEMBERS, SEPTEMBER 30TH, 1878.

Those marked (F) were present at the first meeting when the Society was founded. Those marked (L) are Life Members. Those marked with an asterisk have contributed papers.

HONORARY MEMBERS.

		Date of Election.
Barkely, Sir Henry G.C.M.G., K.C.B.	..	1857
Ellery, R. L. J., F.R.S.	.. Observatory, Melbourne	1876
*(F) Feignagle, C. G.	.. Melbourne	1853
*Garran, A. LL.D.	.. Sydney	1853
*Hull, H. M.	.. Hobart Town	1855
Jervois, H. E. Sir W. F. D., G.C.M.G., C.B.	... Government House	1878
Little, E.	..	1855
Macleay, W., F.L.S.	.. Sydney	1878
Russell, H. C., B.A., F.R.A.S.	Observatory, Sydney	1876
Warburton, Col. P. Egerton	.. Beaumont	1858
*Wilson, C. A.	... Supreme Court	1853
*Woods, Rev. J. E. T., F.L.S., F.G.S., &c.	.. Sydney	1877
(F) Young, J. L.	... Parkside	1853

CORRESPONDING MEMBERS.

*Hayter, H. H., F.S.S.	... Government Statist, Melbourne	1878
*Scoular, Gavin	.. Blair, Smithfield	1878
*Tepper, Otto	.. Ardrossan, Yorke's Peninsula	1878

ORDINARY MEMBERS.

Adamson, Adam, jun.	... Angas-street	1878
*Adamson, D. B.	... Angas-street	1867
Angas, J. H.	... Collingrove, Angaston	1874
Baker, Richmond	... Page-street, off Gouger-street	1868
Bagot, U. N.	... Melbourne-street, N. Adelaide	1877
Biggs, Col.	... Victoria-square	1878
*Bonney, Chas., S.M.	... Glenelg	1855
Brookes, Joseph	... Absent from Colony	1877
Brunskill, George	... Messrs. Stilling & Co., Grenfell-street	1878
Bundey, W. H.	... Pirie-street	1876

Burgan, T. ..	Gilles-street	1858
*Campbell, Hon. Allan, M.D. M.L.C.	North-terrace	1867
*Chalwin, Thos. ...	St. John-street, South-terrace	1877
Chapple, F., B.A., B. Sc. ...	Prince Alfred College	1876
*Clark, A. S.	Grenfell-street	1853
(L) Cooke, E., M.P. ...	South-terrace	1876
Crawford, F.S. ...	Surveyor-General's Office	1865
*Davenport, S. ...	Beaumont	1856
Davidson, Rev. Professor, University of Adelaide ...	Jeffcott-street, N. Adelaide	1876
Dobbie, A. W. ...	Gawler-place	1876
Duffield, W. ...	Gawler	1859
Dumas, V. E. R. ...	King William-street	1877
Elder, Sir Thomas ...	Grenfell-street	1871
Farr, Rev. G. H., M. A. ...	St. Peter's College	1876
*Finniss, Hon. B. T. ...	Stanley-street, N. Adelaide	1873
*Fletcher, Rev. W. R., M.A....	North-terrace, Kent Town	1876
Gall, D. ...	Tynte-street, N. Adelaide	1865
*(F) Gosse, William, M.D. F.R.C.S. ...	North-terrace	1853
Gosse, Chas., M.D. ...	North-terrace	1877
Goyder, G. W., Surveyor-General ...	Government Offices	1862
*Gunson, J. M., M.D. ...	Kent-terrace, Norwood	1877
*Hamilton, George, Commissioner of Police ..	Adelaide Club	1868
Harrold, Arthur ..	Hindley-street	1876
Harry, Thos. ..	Penn Chambers	1878
Hay, Hon. Alexander, M.L.C.	Beaumont	1861
Hickson, R., M.I.C.E., Engineer of Harbours and Jetties ..	Unley	1876
*Hill, W. ..	Kensington-road	1874
*Hosking, J. ..	Brown-street	1855
Hull, W. B., C.E., Assistant Hydraulic Engineer ..	Hydraulic Engineer's Office	1874
*Ingleby, R., Q.C. ..	Carrington-street	1861
Johnson, J. A. ..	Alfred Chambers, Currie-street	1875
*(F) Kay, R., Secretary South Australian Institute ..	College Town	1853
Knevett, S. ..	Carrington-street	1878
*Lamb, Prof. Horace, M.A. University of Adelaide ..	Medindie	1876
*Laughton, E. ..	59, King William-street	1874
Lee, S. E. H., Government Surveyor ..	Survey Office, Adelaide	
Light, G. T., Government Architect ..	Government Architect's Office	1873
*Lloyd, J. S. ..	Lefevre-terrace, N. Adelaide	1856
*Macgeorge, Jas. ..	Green's Exchange	1855
Magarey, T. ..	Enfield	1861
Magarey, A. T. ..	Barton-terrace, N. Adelaide	1873

*Magarey, S. J., M.B.	.. North-terrace	1874
Mayo, G., M.D.	.. Morphett-street	1853
Mayo, G. G., C.E.	.. West-terrace	1874
*Murray, A.	.. Coromandel Valley	1858
(L) Murray, David	.. Hutt-street	1859
Nesbit, E. P., jun.	.. Gilles-street	1875
*Ponton, T. G., F.Z.S.	.. Belgrave-Terrace, Victoria-square	1877
Rees, Rowland, C.E.	.. Waymouth-street	1874
Riddoch, J.	.. Yallum Park, Penola	1866
Ringwood, A., Assistant Observer	.. Adelaide Observatory	1878
*Rutt, Walter, C.E.	Engineer-in-Chief's Office	1869
Salom, M.	.. Lefevre-terrace, N. Adelaide	1866
Sawtell, Dr. T. H.	.. North Adelaide	1878
*Schomburgk, R., Dr.Ph., &c., Director	... Botanic Gardens	1865
*Smeaton, T. D.	... Bank of South Australia	1857
Smith, R. Barr	... Torrens Park, Mitcham	1871
Sparks, Hy.	... Glenelg	1878
Stuckey, J. J., M.A.	... Victoria Chambers, King William-street	1878
*Tate, Prof. Ralph, F.G.S. (University of Adelaide)	... Buxton-street, N. Adelaide	1876
Thomas, J. Davies, M.D.	... North-terrace, Glenelg	1877
Thomas, R. G., Sec. Board of Health	... Unley	1877
Thow, W.	... Locomotive Department, S. A. Railways	1878
*Todd, Chas., C.M.G., F.R.A.S., M. S. T. E., Postmaster-General, Observer, and Superintendent of Telegraphs	... Observatory	1856
Tomkinson, S.	... Bank of Australasia	1876
Townsend, W., M.P.	... King William-street	1878
Verco, Joseph C., M D.	... Wellington-square, N. Adelaide	1878
Vickery, G.	... Meadows	1868
Ware, W. L.	... Victoria Chambers, King William-street	1878
*Waterhouse, F. G., C.M.Z.S., &c., Curator of Museum	... S. A. Institute	1859
Way, His Honor S. J., C.J.	North Adelaide	1859
Way, Dr. E.	... North-terrace	1878
Wragge, —, F.R.G.S.	... Care of R. Ingleby, King William-street	1877
Wyatt, Wm., M.D.	... Burnside	1859

ASSOCIATE.

Smeaton, Stirling	... Medindie	1878

RULES.

ADOPTED MAY 21, 1878.

WHEREAS "The Adelaide Philosophical Society" is incorporated with the South Australian Institution, under the provisions of the South Australian Institute Act, 1863, and it is desirable to consolidate and alter the Rules and Regulations at present existing, it is therefore agreed that the Society shall be governed by the following Rules and Regulations, to the exclusion of all previous rules and regulations:—

1. The title of the Society is "THE ADELAIDE PHILOSOPHICAL SOCIETY."

2. The objects of the Society are the diffusion and advancement of the arts and sciences by the meeting together of the members for the reading and discussion of papers connected with the above subjects, and by other approved means.

3. The Society shall consist of the present members, and of such persons as shall be hereafter elected members.

4. The members shall be classed as follows:—Ordinary Members, Corresponding Members, Honorary Members, and Associates, all of whom shall be elected by ballot.

5. His Excellency the Governor of South Australia for the time being shall be requested to be the Patron of the Society.

FEES.

6. Ordinary members shall subscribe £1 1s. per annum, payable in advance on the 1st day of November to the Honorary Secretary.

7. A member may at any time compound for future annual contributions, that of the current year exclusive, by the payment of the sum of £10 10s.

8. Ordinary members elected during the first half of the financial year shall, within one month after election, pay the full annual subscription of one guinea; but if elected during the second half of the year, they shall pay the sum of half a guinea only as subscription for the remainder of the financial year.

9. Any person who has not paid the year's contribution on or before the 1st day of January shall cease *ipse facto* to be a member of the Society; provided always, that written application for the same shall first have been made by or on behalf of the Treasurer; and provided also, that the Council shall have power to restore the defaulter's name at his request, and after payment of arrears.

ELECTION OF ORDINARY MEMBERS.

10. Every election of a member into the Society shall take place at an Ordinary Meeting only.

11. Every candidate for admission into the Society must be recommended by two members. The certificate setting forth the names, address, and occupation of the candidate, with the names of his proposer and seconder, shall be sent to the Secretary, and shall be read at a Meeting of Council, and also at the following meeting of the Society, and the ballot shall take place at the next following Ordinary Meeting of the Society.

12. The election of members shall be by ballot, one negative in six excluding; and no candidate having been excluded shall be again proposed for admission during the current year.

13. Persons elected shall have immediate notice thereof transmitted to them by the Secretary, accompanied with a copy of the Rules.

14. Members have a right to vote at all meetings to propose candidates for admission into the Society and into the Council of the Society, subject to the Rules touching the election and constitution of the Society. They are eligible to be members of the Council, and shall have access to the library, and shall be furnished with a copy of any transactions, proceedings, or journal which may be published by the Society.

Honorary and Corresponding Members.

15. The Honorary Members shall be persons distinguished for their attainments in science, literature, or art.

16. The Corresponding Members shall be persons residing beyond ten miles from Adelaide, who, by furnishing papers or otherwise, may have promoted the objects of the Society.

17. Every person proposed as an Honorary or Corresponding Member shall be recommended by the Council, and be balloted for as in the case of ordinary members.

18. Honorary or Corresponding Members shall be exempted from payment of fees; they may exercise the privileges or perform the duties of an Ordinary Member, except that they shall not vote or otherwise interfere in the business of the Society, or hold office or seat on the Council.

Associates.

19. Associates shall consist of young men of not more than 21 years of age, and of ladies.

20. Associates shall subscribe 5s. per annum, payable in advance on the 1st day of November, to the Honorary Secretary.

21. The election of Associates shall be after the same manner as in the case of ordinary members.

22. Any Associate failing to pay his or her subscriptions within one month of notice of election, or who shall be three months in arrear with his or her subscription, shall cease to be an associate.

23. Associates shall enjoy all the privileges of members excepting those of taking part in the management of the affairs of the Society, of voting, and of introducing visitors.

24. Any Associate shall be entitled to become an ordinary member of the Society at the first ordinary meeting following the receipt of his application for membership.

Meetings.

25. Meetings of the Society shall be convened by circular to the members resident in the colony. The circular shall state the subjects to be brought before the meeting, the names of the candidates for membership, and any notice of motion.

26. Meetings of the Society shall be held on days to be fixed by the Council; and as far as practicable one meeting shall be held in each month. Each meeting to commence at half-past 7 o'clock p.m.

27. The President, or in his absence one of the Vice-Presidents, shall take the chair; and in the event of the absence of all the above, the members present shall elect a Chairman.

28. The business at the Society's meetings shall be transacted in the following order, unless it be specially decided otherwise :—

I. The reading and confirming the minutes of the last meeting.
II. The nomination of candidates for membership and associateship ; and the election of members and associates.
III. Vacancies among officers, if any, to be filled up.
IV. The transaction of the ordinary business.
V. Motions to be considered, and notices of motion for next meeting to be read.
VI. The consideration of any special matters which members may desire to bring forward subject to the approval of the Chairman obtained before the commencement of the meeting.
VII. At 8 o'clock the paper or subject notified in the circular shall be read.

29. Any member shall be allowed to introduce two visitors upon entering their names in the Visitors' Book. But no visitor shall speak at a meeting of the Society unless specially invited to do so by the Chairman.

30. No paper shall be read at any meeting which has not been previously notified to the Council.

31. Every paper read before the Society shall be the property thereof, and immediately after it has been read shall be delivered to the Secretary and shall remain in his custody.

32. An annual general meeting of members duly convened by circular shall be held in the month of October at half-past 7 o'clock in the evening, on such day as the Council may appoint. In the event of less than ten members being present, it shall not be lawful for the meeting to proceed to business except for the purpose of adjournment, and the meeting shall stand adjourned to a day and time then resolved upon.

33. At the adjourned meeting the members then present may proceed to business although ten members may not be present.

34. The Council shall call a special meeting of the Society, on receiving a requisition in writing, signed by ten members of the Society, specifying the purpose for which the meeting is required, or upon a resolution of its own. No other business shall be entertained at such meeting. Notice of such meeting, and the purpose for which it is summoned, shall be sent to every member, at least seven days before the meeting. Ten members to form a quorum.

35. One member of the Society, not being a member of the Council, shall be chosen at the meeting of the Society next before the month of October in each year as auditor of accounts and balance-sheet of the

Society, and shall examine and certify the same prior to the meeting in October.

THE COUNCIL.

36. The officers of the Society shall be a President, two Vice-Presidents, a Treasurer, and a Secretary, who, with four other members, shall constitute the Council.

37. The Council, on its first meeting, shall appoint one of its members to represent the Society at the Board of Governors of the South Australian Institute.

38. The Council shall have the management of the affairs of the Society.

39. The Council shall meet once in every month for the transaction of business at such time and place as may be appointed. Special meetings of the Council may be convened at any other time on the authority of the President, or of three members of the Council. Due notice of all Council meetings to be sent to each member.

40. No business shall be transacted at any meeting of the Council unless at least four members of the Council are present; in case of equality of votes the Chairman shall have an additional or casting vote.

41. It shall be the duty of the Council to decide on the papers to be read at the monthly meetings, whether by members or non-members; to determine as to the publication, in whole or in part of any paper so read; to prepare a report of the proceedings of the Society for the preceding year, and a balance-sheet of the Society's funds, for presentation at the meeting of the Society held in the month of October; and generally to transact the ordinary affairs of the Society.

42. Any member of Council personally interested in a question before the Council, shall withdraw during its consideration.

43. Every vacancy in the Council shall be immediately filled up at the next meeting of the Society, and by election by ballot. The member, so elected, shall occupy the place of the retiring member.

44. Any member of Council absenting himself from three consecutive ordinary meetings of Council, without satisfactory explanation, shall be considered to have vacated office, and the election of a member, to fill his place, shall be proceeded with in accordance with Rule 43.

ELECTION OF OFFICERS AND MEMBERS OF COUNCIL.

45. All Office-bearers and Members of Council shall retire from office annually at the general meeting in October.

46. The officers and members of Council, so retiring, shall be eligible for the same or any other office.

47. The President, the two Vice-Presidents, Treasurer, and Secretary shall be separately elected by ballot (should such be demanded) in the above-named order, and the four vacancies in the Council shall be filled up together by ballot at the general meeting in October.

SECRETARY.

48. It shall be the duty of the Honorary Secretary to attend and take minutes of the proceedings of the Society and Council respectively, to make the necessary arrangements for meetings, to issue the required notices, to collect the annual subscriptions and to pay them to

the Treasurer, to take charge of all the property under the control of the Society; and generally to transact the ordinary routine business of the Society.

TREASURER.

49. It shall be the duty of the Treasurer to receive all funds belonging to the Society, to pay all accounts approved by the Council, and to render annually an account of all moneys received and expended during his year of office.

ALTERATION OF RULES.

50. The Rules and Regulations of the Society shall not be altered unless a written notice of motion, signed by not less than five members, be given at a meeting of the Society; and thereupon such motion may be brought forward at the next meeting.

51. Any resolution passed as above altering or repealing the Rules and Regulations of the Society shall be in force until the meeting held in the month of October following; and, if not then confirmed, shall thereafter be held void and of no effect.

BYE-LAWS RELATING TO COMMUNICATIONS TO THE SOCIETY.

1. Every paper which it is proposed to communicate to the Society shall be forwarded to the Hon. Secretary for the approval of the Council at least fourteen days before the date of the meeting at which it is desired to be read.

2. The Council may permit a paper written by a non-member to be read if communicated through a member.

3. In the absence of the authors papers shall be read by the Hon. Secretary.

4. No paper or other communication read before the Society shall be published without the consent of the Council.

5. The Council shall decide, not later than at its meeting next following the reading of a paper, whether it shall be printed in the transactions, and if not, such paper shall be returned, if desired, to the author.

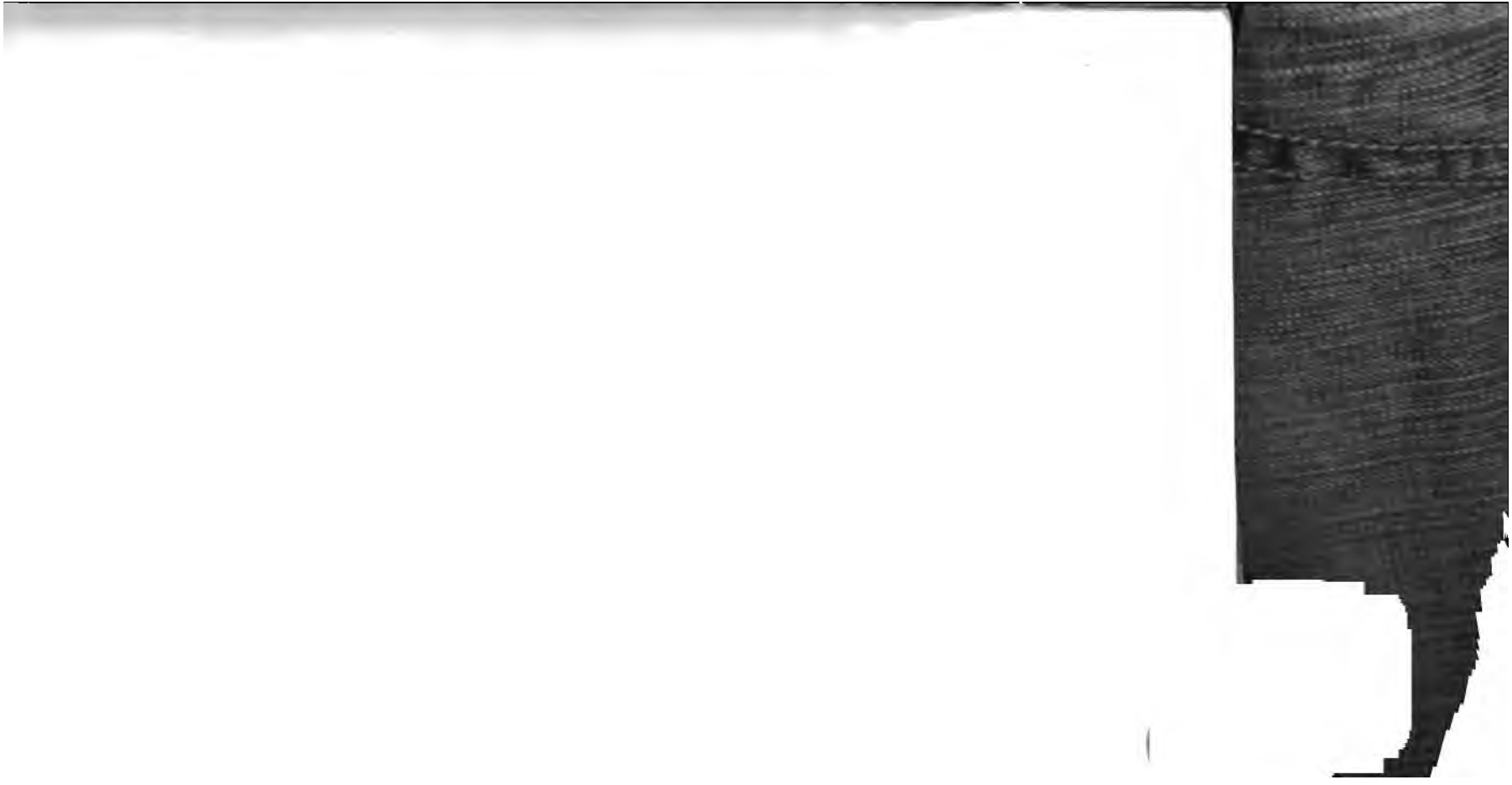
6. All communications intended for publication by the Society shall be clearly and legibly written on one side of the paper only, with proper references, and in all respects in fit condition for being at once placed in the printer's hands.

7. In order to ensure a correct report the Council request that the paper shall be accompanied by a short abstract for newspaper publication.

8. The author of any paper which the Council has decided to publish will be presented with twenty copies, and he shall be permitted to have not more than one hundred copies printed on making application, as per annexed form, to the Hon. Secretary, and on paying the cost of such extra copies.

9. A proof corrected by the MS. shall be submitted to the author, who shall be allowed to make any reasonable amendments therein upon paying the cost of the alterations.

Printed at the "Advertiser" General Printing Office, Adelaide.



TRANSACTIONS AND

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REPC

OF THE

Philosophica

OF

ADELAIDE, SOUTH

FOR 1878

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PRINTED BY WEBB, VARDON, & PRI

Adelaide

1879.

TRANSACTIONS AND PROCEEDINGS

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REPORT

OF THE

Philosophical Society

OF

ADELAIDE, SOUTH AUSTRALIA,

FOR 1878-9.

Adelaide:
PRINTED BY WEBB, VARDON, & PRITCHARD, GRESHAM STREET.
1879.

Philosophical Society of Adelaide.

Patron:

HIS EXCELLENCY SIR W. F. D. JERVOIS, G.C.M.G., C.B., &c.

President:

PROFESSOR RALPH TATE.

Vice-Presidents:

CHARLES TODD, Esq., C.M.G., F.R.A.S., &c.
F. CHAPPLE, Esq., B.A., B.Sc.

Hon. Secretary:

WALTER RUTT, Esq., C.E.

Hon. Treasurer:

THOMAS D. SMEATON, Esq.

Members of Council:

D. B. ADAMSON, Esq.
F. CHAPPLE, Esq., B.A., B.Sc.
R. HICKSON, Esq., M.I.C.E.
S. J. MAGAREY, Esq., M.B.
WALTER RUTT, Esq., C.E.
THOMAS D. SMEATON, Esq.
PROF. R. TATE, F.G.S., &c.
J. C. VERCO, Esq., M.D.
CHARLES TODD, Esq., C.M.G., F.R.A.S., &c.
(REPRESENTATIVE GOVERNOR.)

Assistant Secretary:

MR. A. MOLINEUX.

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LIST OF MEMBERS, SEPTEMBER 30TH, 1879.

Those marked (F) were present at the first meeting when the Society was founded. Those marked (L) are Life Members. Those marked with an asterisk have contributed papers.

		Date of Election.
HONORARY MEMBERS.		
Angas, Geo. French, F.L.S., C.M.Z.S.	Norland-square, London ...	1879
Barkely, Sir Henry, G.C.M.G., K.C.B.	... ...	1857
Ellery, R. L. J., F.R.S.	Observatory, Melbourne ...	1876
*(F) Feignagle, C. G.	Melbourne	1853
*Garran, A., LL.D.	Sydney	1853
*Hull, H. M.	Hobart Town	1855
Jervois, H. E. Sir W. F. D., G.C.M.G., C.B.	Government House ...	1878
Little, E.	... ...	1855
Macleay, W., F.L.S.	Sydney	1878
Russell, H. C., B.A., F.R.A.S ...	Observatory, Sydney ...	1876
Von Mueller, Baron Ferd., K.C.M.G., F.R.S., &c.	Melbourne	1879
Warburton, Col. P. Egerton ...	Beaumont	1858
*Wilson, C. A.	Supreme Court	1853
*Woods, Rev. J. E. T., F.L.S., F.G.S., &c.	Sydney	1877
(F) Young, J. L.	Parkside	1853
CORRESPONDING MEMBERS.		
*Hayter, H. H., F.S.S.	Government Statist, Melbourne	1878
*Scoular, Gavin	Blair, Smithfield	1878
*Tepper, Otto	Ardrossan, Yorke's Peninsula	1878
ORDINARY MEMBERS.		
Adamson, Adam, jun.	Angas-street	1878
*Adamson, D. B.	Angas-street	1867
Addis, W. L.	Currie-street	1879
Angas, J. H.	Collingrove, Angaston ...	1874
Bagot, U. N.	Melbourne-street, N. Adelaide	1877
Biggs, Col. J. H\	Edwardstown	1878
Billiatt, J. W.	Jetty-road, Glenelg ...	1879
Brookes, Joseph	Survey Office	1877
Broom, E. F.	Glenelg	1879
Brunskill, George, J.P.	Morgan	1878
Burgan, T.	Gilles-street	1858
*Chalwin, Thomas	Currie-street	1877
Chapple, F., B.A., B.Sc. ...	Prince Alfred College ...	1876
Coffee, F. R., C.E.	Engineer-in-Chief's Office ...	1879
*(L) Cooke, E., M.P.	South-terrace	1876
Crawford, F. S.	Surveyor-General's Office ...	1865
*Davenport, S.	Beaumont	1856
Davidson, Rev. Professor, University of Adelaide	Jeffcott-street, N. Adelaide ...	1876
Dobbie, A. W.	Gawler-place	1876

Duffield, W	Gawler	1859
Elder, Sir Thomas	Grenfell-street	1871
*Fletcher, Rev. W. R., M.A. ...	North-terrace, Kent Town ...	1876
Gall, D.	Tynte-street, N. Adelaide ...	1865
Giles, E. W.	Government Offices	1877
*(r) Gosse, William, M.D., F.R.C.S.	North-terrace	1853
Gosse, Chas., M.D.	North-terrace	1877
*Gunson, J. M., M.D.	Kent-terrace, Norwood ...	1877
*Hamilton, George, Commissioner of Police	Adelaide Club	1868
Harrold, Arthur	Hindley-street	1876
Harry, Thos.	Penn Chambers	1878
Hay, Hon. Alexander, M.L.C. ...	Beaumont	1861
Hickson, R., M.I.C.E., Engineer of Harbours and Jetties	Unley	1876
*Hill, W.	Kensington-road	1874
*Hosking, J., Inspector of Schools ...	Brown-street	1855
Hull, W. B., C.E., Assistant Hydraulic Engineer	Hydraulic Engineer's Office ...	1874
Hullett, J. W. H., C.E.	Port Augusta	1876
*Ingleby, R., Q.C.	Carrington-street	1861
Johnson, J. A.	Alfred Chambers, Currie-street	1875
*(r) Kay, R., Secretary South Australian Institute	College Town	1853
Knevett, S.	Carrington-street	1878
*Lamb, Professor Horace, M.A. University of Adelaide	Medindie	1876
*Laughton, K.	King William-street ...	1874
Lees, S. E. H.	Survey Office, Adelaide ...	
*Lloyd, J. S.	Lefevre-terrace, N. Adelaide...	1856
*Macgeorge, Jas.	Green's Exchange	1855
Madley, L. G., Principal of Training College	Grote-street	1879
Magarey, T.	Enfield	1861
Magarey, A. T.	Barton-terrace, N. Adelaide ...	1873
*Magarey, S. J., M.B.	North-terrace	1874
Mayo, G., M.D.	Morphett-street	1853
Mayo, G. G., C.E.	Engineer-in-Chief's Office ...	1874
*Murray, A.	Coromandel Valley ...	1858
(L) Murray, David	Hutt-street	1859
Nesbit, E. P., jun.	King William-street ...	1875
*Ponton, T. G., F.Z.S.	Belgrave-terrace, Victoria-sq.	1877
Rees, Rowland, M.P., C.E. ...	Waymouth-street	1874
Russell, W.	Commercial-rd., Port Adelaide	1879
*Rutt, Walter, C.E.	Engineer-in-Chief's Office ...	1869
Sanger, E. B.	Glenelg	1879
Sawtell, T. H., M.R.C.S. ...	North Adelaide	1878
*Schomburgk, R., Doctor Ph., &c. Director	Botanic Gardens	1865
*Smeaton, T. D.	Bank of South Australia ...	1857
Smith, R. Barr	Torrens Park, Mitcham ...	1871
Sparks, H. Y.	Glenelg	1878
Stuckey, J. J., M.A.	Victoria Chambers, King William-street	1878
*Tate, Prof. Ralph, F.G.S. University of Adelaide	Buxton-street, N. Adelaide ...	1876
Thomas, J. Davies, M.D. ...	North-terrace	1877

Thomas, R. G., Sec. of Board of Health	Unley	1877
Thow, W., Locomotive Engineer ...	S.A. Railways	1878
*Todd, Charles, C.M.G., F.R.A.S., M.S.T.E., Postmaster-General, Observer, and Superintendent of Telegraphs	Observatory	1856
Tomkinson, S.	Mount Lofty	1876
Townsend, W., M.P.	King William-street ...	1878
*Verco, Joseph C., M.D.	Wellington-square, N. Adelaide	1878
Vickery, G.	Meadows	1868
Ware, W. L.	Victoria Chambers, King William-street	1878
*Waterhouse, F. G., C.M.Z.S., &c., Curator of Museum	S. A. Institute	1859
Way, His Honor, S. J., C.J. ...	North Adelaide	1859
Way, Dr. E. W.	North-terrace	1878
Wragge, C. L., F.R.G.S. ...	Care of R. Ingleby, King William-street	1877
Wyatt, Wm., M.D.	Burnside	1859

ASSOCIATES.

Smeaton, Stirling	Medindie	1878
Tate, Thos.	Fowler's Bay	1879

RULES.

ADOPTED MAY 21, 1878.

WHEREAS "THE ADELAIDE PHILOSOPHICAL SOCIETY" is incorporated with the South Australian Institution, under the provisions of the South Australian Institute Act, 1863, and it is desirable to consolidate and alter the Rules and Regulations at present existing, it is therefore agreed that the Society shall be governed by the following Rules and Regulations, to the exclusion of all previous rules and regulations:—

1. The title of the Society is "THE ADELAIDE PHILOSOPHICAL SOCIETY."

2. The objects of the Society are the diffusion and advancement of the arts and sciences by the meeting together of the members for the reading and discussion of papers connected with the above subjects, and by other approved means.

3. The Society shall consist of the present members, and of such persons as shall be hereafter elected members.

4. The members shall be classed as follows:—Ordinary Members, Corresponding Members, Honorary Members, and Associates, all of whom shall be elected by ballot.

5. His Excellency the Governor of South Australia for the time being shall be requested to be the Patron of the Society.

FEES.

6. Ordinary members shall subscribe £1 1s. per annum, payable in advance on the 1st day of November to the Honorary Secretary.

7. A member may at any time compound for future annual contributions, that of the current year exclusive, by the payment of the sum of £10 10s.

8. Ordinary members elected during the first half of the financial year shall, within one month after election, pay the full annual subscription of one guinea; but if elected during the second half of the year, they shall pay the sum of half a guinea only as subscription for the remainder of the financial year.

9. Any person who has not paid the year's contribution on or before the 1st day of January shall cease *ipse facto* to be a member of the Society; provided always, that written application for the same shall first have been made by or on behalf of

the Treasurer; and provided also, that the Council shall have power to restore the defaulter's name at his request, and after payment of arrears.

Election of Ordinary Members.

10. Every election of a member into the Society shall take place at an Ordinary Meeting only.

11. Every candidate for admission into the Society must be recommended by two members. The certificate setting forth the names, address, and occupation of the candidate, with the names of his proposer and seconder, shall be sent to the Secretary, and shall be read at a meeting of Council, and also at the following meeting of the Society, and the ballot shall take place at the next following Ordinary Meeting of the Society.

12. The election of members shall be by ballot, one negative in six excluding; and no candidate having been excluded shall be again proposed for admission during the current year.

13. Persons elected shall have immediate notice thereof transmitted to them by the Secretary, accompanied with a copy of the Rules.

14. Members have a right to vote at all meetings, to propose candidates for admission into the Society and into the Council of the Society, subject to the Rules touching the election and constitution of the Society. They are eligible to be members of the Council, and shall have access to the library, and shall be furnished with a copy of any transactions, proceedings, or journal which may be published by the Society.

Honorary and Corresponding Members.

15. The Honorary Members shall be persons distinguished for their attainments in science, literature, or art.

16. The Corresponding Members shall be persons residing beyond ten miles from Adelaide, who, by furnishing papers or otherwise, may have promoted the objects of the Society.

17. Every person proposed as an Honorary or Corresponding Member shall be recommended by the Council, and be balloted for as in the case of ordinary members.

18. Honorary or Corresponding Members shall be exempted from payment of fees; they may exercise the privileges or perform the duties of an Ordinary Member, except that they shall not vote or otherwise interfere in the business of the Society, or hold office or seat on the Council.

Associates.

19. Associates shall consist of young men of not more than 21 years of age, and of ladies.

20. Associates shall subscribe 5s. per annum, payable in

advance on the 1st day of November, to the Honorary Secretary.

21. The election of Associates shall be after the same manner as in the case of ordinary members.

22. Any Associate failing to pay his or her subscriptions within one month of notice of election, or who shall be three months in arrear with his or her subscription shall cease to be an Associate.

23. Associates shall enjoy all the privileges of members excepting those of taking part in the management of the affairs of the Society, of voting, and of introducing visitors.

24. Any Associate shall be entitled to become an ordinary member of the Society at the first ordinary meeting following the receipt of his application for membership.

Meetings.

25. Meetings of the Society shall be convened by circular to the members resident in the colony. The circular shall state the subjects to be brought before the meeting, the names of the candidates for membership, and any notice of motion.

26. Meetings of the Society shall be held on days to be fixed by the Council; and as far as practicable one meeting shall be held in each month. Each meeting to commence at half-past 7 o'clock p.m.

27. The President, or in his absence one of the Vice-Presidents, shall take the chair; and in the event of the absence of all the above, the members present shall elect a Chairman.

28. The business at the Society's meetings shall be transacted in the following order, unless it be specially decided otherwise:—

I. The reading and confirming the minutes of the last meeting.

II. The nomination of candidates for membership and associateship; and the election of members and associates.

III. Vacancies among officers, if any, to be filled up.

IV. The transaction of the ordinary business.

V. Motions to be considered, and notices of motion for next meeting to be read.

VI. The consideration of any special matters which members may desire to bring forward subject to the approval of the Chairman obtained before the commencement of the meeting.

VII. At 8 o'clock the paper or subject notified in the circular shall be read.

29. Any member shall be allowed to introduce two visitors upon entering their names in the Visitors' Book. But no visitor shall speak at a meeting of the Society unless specially invited to do so by the Chairman.

30. No paper shall be read at any meeting which has not been previously notified to the Council.

31. Every paper read before the Society shall be the property thereof, and immediately after it has been read shall be delivered to the Secretary and shall remain in his custody.

32. An annual general meeting of members duly convened by circular shall be held in the month of October at half-past 7 o'clock in the evening, on such day as the Council may appoint. In the event of less than ten members being present, it shall not be lawful for the meeting to proceed to business except for the purpose of adjournment, and the meeting shall stand adjourned to a day and time then resolved upon.

33. At the adjourned meeting the members then present may proceed to business although ten members may not be present.

34. The Council shall call a special meeting of the Society, on receiving a requisition in writing, signed by ten members of the Society, specifying the purpose for which the meeting is required, or upon a resolution of its own. No other business shall be entertained at such meeting. Notice of such meeting, and the purpose for which it is summoned, shall be sent to every member at least seven days before the meeting. Ten members to form a quorum.

35. One member of the Society, not being a member of the Council, shall be chosen at the meeting of the Society next before the month of October in each year as auditor of accounts and balance-sheet of the Society, and shall examine and certify the same prior to the meeting in October.

THE COUNCIL.

36. The officers of the Society shall be a President, two Vice-Presidents, a Treasurer, and a Secretary, who, with four other members, shall constitute the Council.

37. The Council, on its first meeting, shall appoint one of its members to represent the Society at the Board of Governors of the South Australian Institute.

38. The Council shall have the management of the affairs of the Society.

39. The Council shall meet once in every month for the transaction of business at such time and place as may be appointed. Special meetings of the Council may be convened at any other time on the authority of the President, or of three members of the Council. Due notice of all Council meetings to be sent to each member.

40. No business shall be transacted at any meeting of the Council unless at least four members of the Council are present. In case of equality of votes the Chairman shall have an additional or casting vote.

41. It shall be the duty of the Council to decide on the papers to be read at the monthly meetings, whether by members or non-members; to determine as to the publication, in whole or in any part, of any paper so read; to prepare a report of the proceedings of the Society for the preceding year, and a balance-sheet of the Society's funds, for presentation at the meeting of the Society held in the month of October; and generally so transact the ordinary affairs of the Society.

42. Any member of Council personally interested in a question before the Council shall withdraw during its consideration.

43. Every vacancy in the Council shall be immediately filled up at the next meeting of the Society, and by election by ballot. The member so elected shall occupy the place of the retiring member.

44. Any member of Council absenting himself from three consecutive ordinary meetings of Council without satisfactory explanation shall be considered to have vacated office, and the election of a member to fill his place shall be proceeded with in accordance with Rule 43.

Election of Officers and Members of Council.

45. All Office-bearers and Members of Council shall retire from office annually at the general meeting in October.

46. The officers and members of Council so retiring shall be eligible for the same or any other office.

47. The President, the two Vice-Presidents, Treasurer, and Secretary shall be separately elected by ballot (should such be demanded) in the above-named order, and the four vacancies in the Council shall be filled up together by ballot at the general meeting in October.

Secretary.

48. It shall be the duty of the Honorary Secretary to attend and take minutes of the proceedings of the Society and Council respectively, to make the necessary arrangements for meetings, to issue the required notices, to collect the annual subscriptions and to pay them to the Treasurer, to take charge of all the property under the control of the Society; and generally to transact the ordinary routine business of the Society.

Treasurer.

49. It shall be the duty of the Treasurer to receive all funds belonging to the Society, to pay all accounts approved by the Council, and to render annually an account of all moneys received and expended during his year of office.

Alteration of Rules.

50. The Rules and Regulations of the Society shall not be

altered unless a written notice of motion, signed by not less than five members, be given at a meeting of the Society; and thereupon such motion may be brought forward at the next meeting.

51. Any resolution passed as above altering or repealing the Rules and Regulations of the Society shall be in force until the meeting held in the month of October following; and if not then confirmed, shall thereafter be held void and of no effect.

BY-LAWS RETATING TO COMMUNICATIONS TO THE SOCIETY

1. Every paper which it is proposed to communicate to the Society shall be forwarded to the Hon. Secretary for the approval of the Council at least fourteen days before the date of the meeting at which it is desired to be read.

2. The Council may permit a paper written by a non-member to be read if communicated through a member.

3. In the absence of the authors papers shall be read by the Hon. Secretary.

4. No paper or other communication read before the Society shall be published without the consent of the Council.

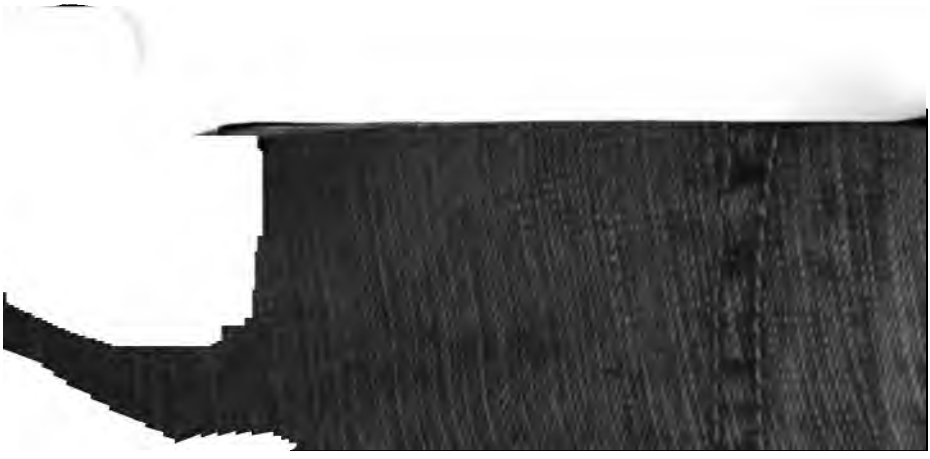
5. The Council shall decide, not later than at its meeting next following the reading of a paper, whether it shall be printed in the transactions, and if not such paper shall be returned if desired to the author.

6. All communications intended for publication by the Society shall be clearly and legibly written on one side of the paper only, with proper references, and in all respects in fit condition for being at once placed in the printer's hands.

7. In order to ensure a correct report the Council request that the paper shall be accompanied by a short abstract for newspaper publication.

8. The author of any paper which the Council has decided to publish will be presented with twenty copies, and he shall be permitted to have not more than one hundred copies printed on making application, as per annexed form, to the Hon. Secretary, and on paying the cost of such extra copies.

9. A proof corrected by the MS. shall be submitted to the author, who shall be allowed to make any reasonable amendments therein upon paying the cost of the alterations.



TRANSACTIONS, PROCEEDINGS, AND REPORT

OF THE

Philosophical Society of Adelaide,

FOR 1878-9.

ABSTRACT OF PROCEEDINGS.

ORDINARY MEETING, NOVEMBER 5, 1878.

Professor TATE, F.G.S., President, in the chair.

Dr. Sawtell and Mr. H. Y. Sparks elected ordinary members.

The HON. SECRETARY laid upon the table—"Statistical Register of Victoria for 1877," "Meteorological Observations at Adelaide Observatory, 1877," also for April, 1878.

Mr. THOS. D. SMEATON showed two dissimilar pictures, one being a photographic copy of the other. The original was printed in blue and yellow colours, the blue being very distinct and the yellow scarcely visible. In the photographic copy the yellow came out quite strongly, whilst the blue was nearly absent. The pictures illustrated a new system of bank-note printing, whereby forgery by means of photography can be rendered impossible in the present state of that art.

Mr. CHAS. TODD mentioned an error made by the President in his inaugural address at last meeting, with respect to the space proposed to be devoted to Museum purposes in the projected western wing of the new Institute buildings.

Dr. S. J. MAGAREY read a paper, illustrated by outline map of South Australia, and by diagrams showing thermometrical ranges, degrees of humidity, and deathrates per 1,000 of children under one year of age, in the colonies of Tasmania, New Zealand, New South Wales, Queensland, Victoria, and South Australia, entitled "Our Climate, and Infant Mortality." (See page 1.)

Discussion ensued.

Mr. G. H. HAMILTON asked if it could not be fairly assumed that the excess of infant mortality in large centres of population, such as Port Adelaide and towns on Yorke's Peninsula,

was attributable to the enfeebled constitutions of many of the parents, caused by drink and other vices.

Mr. R. INGLEBY thought the paper just read was one of the most valuable that had ever been read before the Society. The conclusions arrived at by Dr. Magarey fully confirmed his own observations. He did not know whether intemperance in the parents affected the question or not, but pointed out that in the mining districts of Yorke's Peninsula and at Port Adelaide, where the greatest mortality amongst infants prevailed, there were the greatest numbers of teetotallers. (Hear, hear, and "It was the drunkenness that was the cause of the teetotalism.") He proposed a vote of thanks to Dr. Magarey.

Dr. J. M. GUNSON seconded. He did not think that vice and intemperance in the mother was the cause of the excess of deaths of infants under one year in South Australia, for the women in Victoria were quite as vicious and intemperate, and yet the infant deathrate was less per 1,000. The sanitary state of the city in respect to drainage could be tested by the prevalence or absence of typhus or typhoid fever, and in Adelaide during the past year there had been less of this fever than for some time previously. He agreed with Dr. Magarey that the extreme heat and dryness of our summer days was the cause of the excess of infant deaths as compared with the other colonies. At first the heat had a stimulating effect, but afterwards a reaction was set up, and then it became depressing. This was illustrated by the activity displayed by adults during the first days of a hot period, and the lassitude experienced towards the end. He alluded to the necessity for supplying infants with moisture or water in the hot weather, and for being more careful in regulating the clothing to the heat indicated by the thermometer. The question suggested itself—"Can we adopt any method of making the climate cooler?" The influence of trees on climate was well known. The leaves during the day absorbed solar heat, reducing the temperature, and converting heat energy into vital energy; leaves had also a strong purifying effect upon the atmosphere, and, by exhalation, tended to produce a healthy humidity in the air. There was an enormous surface in inches of leaf-surface in one of our large eucalypts, and the evaporation of moisture from any such surface was far greater than that which was received from an equal space of atmosphere by precipitation. If the Park Lands and open spaces were planted with trees, shrubs, and flowers, instead of being left dry, parched, and arid, as at present, not only would the space be made more healthy, but the city would be rendered far more attractive and agreeable to our visitors.

Mr. CHARLES TODD suggested that breaking up the soil and

planting belts of trees in an east and west direction would have a beneficial influence. He thought Dr. Magarey had not laid sufficient stress upon the great and sudden fluctuations of temperature—sometimes as much as 45 deg. in 24 hours. These fluctuations, probably, had much influence on infant mortality, more than if the rise and fall were more gradual. He had noticed in the Northern Territory, Queensland, and other similar countries, that women stood the moist heat better than men. With regard to the diagrams, he was hardly prepared to find so great a range in Queensland.

Mr. W. Rutt, referring to the diagram showing mortality, temperature, &c., suggested that temperature rather than dryness had the greater effect upon human life. It had been suggested that intemperance in parents was a cause of infant deaths in centres of population such as Port Adelaide and on Yorke's Peninsula, but he pointed out that intemperance and teetotalism were co-existent in those localities.

Dr. Magarey explained that his map was compiled from the official returns of the Registrar-General, which gave the deaths for each district, and that would account for the district of Yorke's Peninsula being coloured so deeply, whilst the adjoining district of Kangaroo Island, containing few inhabitants, was comparatively colourless.

Professor Tate was much pleased with the map in most particulars, but of course it was too highly coloured in some localities. The population of the Peninsula was centralised at the mines, but was sparse in the other portions. In reality, the southern end being almost surrounded with water and therefore possessing a cool and moist atmosphere, ought to be as healthy as Kangaroo Island.

Mr. R. Ingleby suggested that the upper storeys of houses should be more used for living rooms, in which the inhabitants would escape the dangers arising from bad drainage and noxious gases. He thought the extensive use of Glen Osmond stone was one cause of the great heat experienced in Adelaide. The walls became thoroughly heated, and absorbed a great deal more heat than white stone would do.

Mr. Magarey, senr., thought if white stone were used, instead of blue slate, for pavements, ophthalmia would be far more prevalent through radiation and reflection of light. In Tasmania there were very many old people, and naturally there would be a greater proportion of deaths of adults than of infants. In New Zealand, where towns were more scattered, the deaths were, comparatively, not so numerous—especially on the elevated lands—but in the lower and thickly-populated towns the deathrates were much higher. In planting trees he thought they should not forget the wattle, the gum of which,

eaten in quantities by children, seemed to be beneficial to them. The acid principle contained in the sheaoak apples also seemed to be beneficial to them. He considered Port MacDonnell a more healthy place for summer resort than either Victoria, Sydney, or Tasmania. He considered a railway to the hills a matter of national importance, as by that means persons engaged in town during the heat of the day in summer could retire to the hills at night and recuperate their exhausted energies. In his experience with children—and he had brought up a few—he found that they throve when allowed to sleep and play in the lower rooms during hot weather, but when kept on the second floor they drooped, and when taken to the top storey they became prostrated—proving that coolness was necessary to their health.

Mr. G. H. HAMILTON wished some one would speak a good word for our climate. What with Glen Osmond stone, blue slate, heat, &c., a stranger would think we possessed a climate like that of Cape Coast Castle. He arrived in the colony at a very early period in its history, and had managed to live through all the fearful and fatal changes of temperature. He had not found the climate affect him since his arrival in 1839, but then he was more than one year old.

Dr. J. M. GUNSON remarked that the comparisons of infant mortality made that evening were between the Australian colonies only, in which comparisons South Australia came out unfavorably; but our deathrate was not so great as in England, and it was considerably lower than in many other countries.

Dr. S. J. MAGAREY said he had stated that our climate was favorable to adults. He found that the upper rooms in his house were much warmer than the lower, the top rooms being hot, the next below being warm, and the lowest cool. He believed the planting of wattles would be beneficial in many ways. He had found an infusion of the bark very useful in some cases during his practice.

Mr. ADAMSON suggested that Dr. Gunson should give a paper upon "Tree-planting, and its effect upon Climate."

Dr. J. M. GUNSON promised if possible to do so.

The vote of thanks to the author was carried.

ORDINARY MEETING, DECEMBER 3, 1878.

Professor R. TATE, F.G.S., President, in the chair.

The HON. SECRETARY laid upon the table—"The Victorian Year Book," by H. H. Hayter; "On Evaporation, Rainfall, and Elastic Force of Vapour," by J. R. Mann.

Mr. E. W. Way, physician, was nominated as an ordinary member, and Mr. E. H. Lees, surveyor, was elected an ordinary member.

Professor TATE mentioned that in Mr. Rawlinson's recent lecture upon "Our Water Supply" it was suggested that much of the salt water in South Australia might be attributed to sea water enclosed by upheaval of surrounding land and evaporated. He had seen a pit at North Adelaide, sunk to a depth of fifteen feet, and was led to a different conclusion. The first six feet from the surface was composed of travertine, the top being very dense, the remainder becoming softer until it might be compared to marl. The rest of the depth consisted of red and blue clay, on the top of which brackish water was obtained. Deep beneath this clay came marls, filled with marine fossils. He thought the red and blue clays were the result of deposit under circumstances unfavorable to animal life, such as a mixture of salt and fresh water. The fact that fresh water could be obtained by sinking through these strata, and by keeping back the soakage from above, he thought proved that the salt in the upper strata was obtained by concentration of the saline ingredients of surface soakage.

Prof. TATE showed a fossil head and shoulders of a fish found in the marine limestone of Morgan, Murray River, which he described as unique. The sclerotic ring, encircling the eye, was well preserved; the dorsal fin and spines were very stout and long, and the pectoral fins were also well developed. The scales were large and distinct, greatly resembling those of a schnapper, but apparently stouter. The ctenoid scales proved it to be a perch, probably resembling the Beryx, a sea perch now existing, fossils of which had been found in the chalk formation.

Mr. C. A. WILSON read a letter (illustrated by a map and a book of coloured drawings) received by him from his nephew, the Rev. C. T. Wilson, Missionary to the first and second parties sent by the Church of England Missionary Society to the Victoria Nyanza, in Central Africa, of both of which parties he is the sole survivor—the first having been destroyed by fever, and the second massacred by the natives.

The Hon. B. T. FINNISS read a paper upon "The Philosophy of Consciousness."

Votes of thanks were accorded to both gentlemen.

It was resolved that Mr. Finniss's Paper should be discussed at the next meeting.

ORDINARY MEETING, JANUARY 7, 1879.

Professor R. TATE, F.G.S., President, in the chair.

The HON. SECRETARY laid upon the table six papers upon conchology—chiefly South Australian shells—by G. F. Angas, Esq.; a list of the publications of the South Australian Institue; Australian Statistics, by H. H. Hayter.

Dr. E. Way was elected an ordinary member.

Letter and report of Committee received from Adelaide University in reply to communication forwarded by the Council of Philosophical Society, in February, 1877, urging the importance of providing special training for students in mining engineering. Report dated December, 1878, as follows:—

"Your Committee have the honour to report—1. That they have carefully considered the Adelaide Philosophical Society's resolution urging on the Council the great importance of providing special training for students in mining engineering, and the Society's suggestion to add to the University curriculum such special subjects as will carry out the object of the resolution until the Government is in a position to take up the subject more fully. 2. In considering the foregoing resolution and suggestion your Committee have been greatly aided by the valuable reports furnished by Captain Hancock, Mr. Higgs, and Professor Tate, and by various papers and reports as to the School of Mines at Ballarat, which the Hon. the Minister of Education has obligingly procured from the Government of Victoria. 3. From the documents referring to the School of Mines at Ballarat it appears that the institution expends about £1,800 per annum, and although the University is only requested to add special subjects to its curriculum your Committee are of opinion that the efficient teaching of those subjects would necessitate a larger staff of lecturers and an increased expenditure in other ways which they cannot recommend to the Council to undertake at present. 4. Your Committee do not believe that a sufficient number of students would avail themselves of the 'special training,' and of the instructions in special subjects recommended by the Philosophical Society to justify the Council in incurring the expense necessary for those purposes, and they are also of opinion that the establishment in mining centres of classes for the study of subjects specially connected with a particular industry would be beyond the function of the University. 5. If at any future time a School of Mines shall be established by the Governmgnt or by means of funds specially subscribed for that purpose it may be properly affiliated to this University, but your Committee are of opinion that to comply with the suggestions of the Philosophical Society would at present be premature. 6. Your Committee beg to recommend that a copy of this report be transmitted to the Society with an expression of the Council's regret that they find themselves unable for these and other reasons to adopt the Society's suggestions on the very important subject to which its resolution is directed.—S. J. Way, Vice-Chancellor, December 6, 1878."

Mr. W. Rutt moved—"1. This Society views with concern

the depressed state of the mining interest in this colony, and the possibility of a long continuance of the present low price of copper, and feels that the only hope of reviving this interest lies in a greater economy of production, resulting from the intelligent application of science to the processes of seeking, raising, and treating the ores.

"2. While thanking the Council of the University for the careful consideration which it has given to the suggestions contained in the letter forwarded from this Society on the 20th February, 1877, and acknowledging the force of the objections raised by the Council to the establishment by the University of a department commensurate with the School of Mines at Ballarat, the Society begs to suggest to the Council that its curriculum already comprises several branches of knowledge bearing upon this subject, and that by the addition of a comparatively small number of subjects it might arrange for a course of study which would greatly advance the object sought, and would, by giving prominence to the importance of this question, pave the way for a more comprehensive scheme.

"3. This Society believes that although the number of students availing themselves of the suggested course might at first be small, it would rapidly increase, and that the University has in its power to stimulate the desire for higher scientific attainments on the part of those who intend to devote themselves to this important industry, and thus to confer a lasting benefit upon this community."

The motion was carried, the Hon. B. T. Finniss and Professor Tate remarking that they did not think a larger staff was required.

Letter read from Mr. W. McLeay, Sydney, acknowledging the honour done him in electing him honorary member.

Mr. Thomas Tate showed some fine specimen of *Corbicula Angasi* found by him in the Torrens at the Reedbeds.

Professor Tate read some notes upon the Conchology of King George's Sound, concluding with a few remarks upon a new species of *Lepidurus* which he had named *viridulus*.

Discussion upon Hon. B. T. Finniss's Paper, "The Philosophy of Consciousness."

Mr. Harry said crises occurred in the lives of every thoughtful man when the consciousness of existence was unusually strongly marked, and the puzzling question would thrust itself on one, "How is it, not that I exist, but that, existing, I am conscious of my existence?" Man was the only one of which it could be said that he was absolutely conscious of his own existence, and indeed with many of the most thoughtful of the race the two facts in respect to which alone they would undertake to be positive were that they existed and were conscious

of that existence. No room was left by the theories laid down by Mr. Finniss for the soul and spirit as distinct from matter, though he did not deny their existence. But those who would summarily dispose of the non-material part of man left out one or two important factors from the calculation of the sum of existence. The passions, fear, hope, joy, grief, love, all the emotions that imparted colour to the ever-changing kaleidoscope of life, were not matter. This admitted, the materialist theory of life was much shaken. Of the two he would rather incline to the transcendental theory, which threw matter rather into the background.

Mr. W. Hill also spoke upon the subject.

The Hon. B. T. Finniss, in reply, said he was glad that the discussion had taken place. Mr. Harry had said he lived, and wanted to know how he lived. That was just the difficulty he (Mr. Finniss) had experienced in writing his paper. He had said that a man being run through by a bayonet felt pain, but how motion of a violent kind became converted into consciousness they could not tell. They knew that every action on the nerves was transmitted to the brain, which received and interpreted it; but they did not know why it was so. He expected that during the discussion the transcendentalist would speak out and oppose him on some of the views on materialist grounds which he had taken. He would like to hear arguments in their favour. They knew that the primary forces of nature existed, and the transcendentalist would have to prove that forces existed independent of matter. But before those proofs were brought he must hold the materialist views he had expressed in his paper. It had been said that consciousness belonged to man alone, but he was of opinion that it was traceable to animals as well. He referred to dogs, and said that they were conscious that they were different from other animals around them. He would be very glad if any one else would throw any more light on the subject.

Ordinary Meeting, February 4, 1879.

Mr. D. B. Adamson, Member of Council, in the chair.

The Hon. Secretary laid upon the table—"Statistical Register of the Colony of Victoria for 1877, Part vii., Law, Crime, &c.," by H. H. Hayter.

Mr. Carl Umbehaun elected an ordinary member.

Mr. Thos. Tate elected an associate.

The Chairman (Mr. D. B. Adamson) laid on the table several remarkably fine ears of wheat which had been grown in California by a Mr. Phelps on land which had not had rain upon it from the time of sowing the seed to the time of reaping the wheat. He also stated that Mr. Phelps had raised

potatoes on the same field, which were three inches in diameter notwithstanding that no rain had fallen between the sowing of the seed and raising of the crop. These results, it was said, were owing to the natural moisture, and were not due to irrigation.

The ASSISTANT SECRETARY laid upon the table specimens of a substance found on Kangaroo Island, and supposed by the discoverers to be coal, or an indication of coal. It was not claimed that the existence of this substance on the island was a new discovery, but the men stated that they had found the place whence it originated in a spring within a cave on the south coast. In his opinion the substance was a form of petroleum.

The HON. SECRETARY read a paper by Mr. J. D. Woods on "The Aborigines of South Australia." (See p. 81)

A desultory sort of discussion followed, regret being generally expressed that Mr. Woods was not present to supply information upon several matters not touched upon in the paper.

Mr. R. INGLEBY said it appeared to him that there was no accumulation of wealth among the aboriginals, and yet Mr. Woods spoke of the men "buying" their wives. He could scarcely see what the exchange could be. Another matter on which he should like to have heard something was in reference to the custom of some of the blacks of taking a cast of the head of a corpse and allowing it to remain on for some time.

Mr. A. MOLINEUX said he thought it was a practice observed by the female relatives of the deceased, who plastered mud upon their heads and let it remain until it became thoroughly set. They then placed it on the grave of the deceased. He arrived in the colony in 1839, and had seen a great deal of the habits and customs of the blacks. He remembered once seeing the funeral of one of their men, whom they called King John. After death a number of the tribe put him on a lot of sticks, and after smoking him for a considerable time carried him about for nearly a fortnight before the obsequies were finally concluded. During the time there were great lamentations, the "gins" especially making a fearful noise and evincing great distress. Special honor, he thought, was shown to John on account of his position, because he always found that the ordinary members of a tribe were buried without such display, and their bones were broken up and put indiscriminately into the graves. That accounted for the accumulation of bones that were sometimes found on the banks of the Torrens when a landslip had exposed some old native burying ground. Along the banks of the Coorong it was a common practice of the blacks to hide their dead in the branches of trees, and even

now the remains were to be seen in the branches of what was known as the cockatoo bush. (Mr. Ingleby—"Hear, hear.") He wondered that Mr. Woods had not referred to the fact.

Mr. R. G. Thomas said Mr. Woods spoke of the Port Jackson blacks using bows and arrows. He had never heard of such being the case, and was sorry Mr. Woods was not present to give his authority. Nothing had been said in the paper about the blacks being specially fond of a particular kind of fat in the body, which they generally took from any human victim who fell into their hands, or even from the dead of their own tribe.

Mr. Ingleby said there appeared, too, to be no doubt that the natives had recognised doctors amongst them. He had heard of the bones of a human skeleton being perfectly articulated by one of their doctors.

Mr. Molineux said with regard to eating fat, he had often heard the blacks speak of killing a native of another tribe for his kidney fat.

Mr. Rutt said with regard to the special honors which seemed to be paid to some natives at their death, he thought it was owing to their royalty. He remembered once a native queen being buried at Upper Kensington with similar rites and ceremonies to those which had been described. In his opinion it was only because of her royal position.

Mr. Molineux said he did not think there was any recognised royal family among the blacks. Any man among them who was of powerful physique or displayed any special daring or intelligence, was respected above all others, and recognised as their great leader or chief.

The Hon. B. T. Finniss said he remembered King John very well. He was a man of very powerful frame and commanding appearance. Reference had been made to the question of half-castes among the blacks. Several theories had been advanced as to whether there was or was not any dislike to them on the part of the blacks. He remembered being at Rapid Bay in 1838, and being camped with a small party, including a few friendly blacks, among whom were a native and his lubra and a half-caste child. The night was very rough, and the child cried a great deal. The black man, however, got up and attended to it, and treated it entirely as his own, and showed anything but a dislike to it.

Mr. Ingleby said in his opinion the blacks showed no special dislike to half-caste children.

Mr. Molineux endorsed Mr. Ingleby's opinion, but said he once heard a black say in reference to a half-caste child that he did not like its red hair, and the mother subsequently

confessed to having eaten it because it was too much like "warrigal" (wild dog).

Mr. F. Chapple said he was once at Point Sturt, and drew attention to a half-caste child amongst the blacks, when a resident said to him, "Don't appear to notice it; they don't like it."

The Hon. B. T. Finniss, in referring to many of the extraordinary and revolting customs of the aboriginals at certain periods of life, said in the interests of the Society as a scientific institution he thought a record of them should be preserved, even if the description were given in one of the dead languages. He hoped as Mr. Woods promised to take up the subject again that he would not overlook that point.

On the motion of Mr. Ingleby, seconded by Mr. Chapple, a vote of thanks was accorded to Mr. Woods for his paper.

Ordinary Meeting, March 11, 1879.

Mr. Rupert Ingleby, Q.C,, Vice-President, in the chair.

The Hon. Secretary laid upon the table—

"Statistical Register of Victoria, 1877," Parts VIII. and IX.

"Observations at Adelaide Observatory," May and June, 1878.

Circulars *re* Melbourne Exhibition.

Dr. J. C. Verco was elected a member of the Council, *vice* Jas. MacGeorge resigned by non-attendance.

Dr. J. C. Verco read a paper upon "Statistics of Consumption in South Australia," (see page 11).

Mr. Thos. D. Smeaton thought immigration influenced the statistics of consumption in this colony, which, having the reputation of possessing a dry climate, was resorted to by persons suffering from that complaint in the hope of deriving benefit from so doing. He had made a diagram, and found that between the ages of 15 and 45 more died than were born, which showed the effect of immigration, and that the large bulk of the population were aged between those years.

Mr. Rutt suggested that Dr. Verco should move with a view to getting the information desired inserted in the return.

Mr. Ingleby said there was no power to compel the doctors to fill in the returns.

A gentleman observed that children inherited consumption, even though the parents came here and recovered their health.

Dr. Verco agreed with Mr. Smeaton in thinking that the number of deaths registered as having occurred from consumption was masked by immigration, and that it arose very largely from immigration of persons suffering, who before leaving home or very soon after arrival were consumptive. It would be well if the doctors could be induced to fill up in their returns the time at which persons dying came into the colony.

Ordinary Meeting, April 1, 1879.

Professor Tate, F.G.S. (President) in the chair.

The Hon. Secretary laid upon the table—

"The True Theory of the Earth, and Philosophy of the Predicted 'End,'" by an anonymous author.

"Observations at the Adelaide Observatory," July, 1878.

"Annual Report, Adelaide Botanic Garden."

Professor Tate said at an early date it would give him pleasure to supplement the information which had already been published respecting his recent trip to Eucla, and also to illustrate his paper with specimens of various kinds, provided he could get them ready in time.

Mr. U. N. Bagot suggested that in view of the present interest taken by the public in the subject, some information upon the subject of artesian wells would be useful.

Professor Tate did not agree with Mr. Bagot in that matter. It was not within the province of the Philosophical Society to institute lectures upon such matters as could be found in ordinary text-books, and he considered that persons who were perhaps interested pecuniarily in the matter should not be enabled to come there and receive for nothing information for which they would otherwise have to employ professional assistance in obtaining.

The Hon. Sec. then read a paper, written by Mr. Otto Tepper, upon "The Rocks and Cliffs of Ardrossan" (see p. 71), illustrated with coloured sections, sketches and diagrams.

Ordinary Meeting, May 26, 1879.

Professor R. Tate, F.G.S., President, in the chair.

The Hon. Secretary laid upon the table—

"Observations at the Adelaide Observatory," September, 1878.

"Statistics of Victorian Friendly Societies," by H. H. Hayter.

"Index to Victorian Statistics"

The Chairman congratulated the members upon the increased interest taken in the Society, as evidenced by the late accessions of members, and trusted that this would lead to more work being accomplished. He mentioned that copies of the "Journal of Proceedings and Reports" were ready for distribution to such of the members as had paid up their subscriptions.

Mr. F. Chapple, B.A., B.Sc., then took the chair.

Professor Tate read a paper upon "The Physical Features and Natural History of the Country around the Great Bight," illustrated by diagrams and specimens.

Mr. S. Tomkinson suggested a continuance of the paper at some future time.

It was resolved that all discussion upon the subject should be postponed to a future date, and Professor Tate promised to exhibit his specimens again.

Ordinary Meeting, June 3, 1879.

Professor R. Tate, F.G.S., President, in the chair.

The Hon. Secretary laid upon the table—

"Transactions of the Royal Society of Victoria." vol. 15.

"Results of Rain Observations in New South Wales during 1878," by H. C. Russell, B.A., F.R.A.S.

"Some Talk about the Great Tidal Wave of May, 1877," by J. C. Josephson, C.E.

The following persons were elected ordinary members:—

William Addis, merchant, Currie-street, Adelaide.

Edward F. Broom, accountant, Victoria-square, Adelaide.

Francis F. Coffee, C.E., Engineer-in-Chief's Office, Pirie-street, Adelaide.

Louis G. Madley, Principal of Training College, Grote-street, Adelaide.

Edward B. Sanger, naturalist, Glenelg.

A specimen of *Paradisea regia*, sent to the Museum by Mr. C. Peacock, was exhibited.

Mr. D. B. Adamson produced a sheet of fungus, presenting the colour and general appearance of tanned sheepskin, about one-eighth of an inch in thickness, which he had taken from between the annular layers of a red gum log. On touching a piece of this substance with fire it burned like touchwood.

Mr. Charles Todd, Chief Government Astronomer, offered some remarks upon the approaching conjunction of Mars and Saturn.

Mr. Charles Todd then took the chair, and the adjourned discussion upon Professor Tate's paper upon "The Physical Features and Natural History of the Country around the Great Bight" was resumed.

Mr. S. Tomkinson complimented the Professor for so boldly expressing his opinion with regard to the improbability of finding water in the country referred to, though it was known that such an opinion would be unpopular. The Government had wisely availed themselves of the services of the Professor, and now that he had reported upon it, they might with magnanimity leave it to the natives, who best knew how to avail themselves of its resources.

The Hon. B. T. Finniss wished to ask to what geological age the cliffs of the Great Bight might be assigned, and if they were contemporaneous with the chalk cliffs of England?

Professor TATE read a portion of his paper in which he expressed his opinion on that point. (See page 94.)

Mr. T. G. PONTON, F.Z.S., asked whether the skulls of the natives of the Bunda Plateau were different from those of the tribes nearer Adelaide.

Professor TATE had not studied the matter, but he had brought back material for those who were interested in the subject. He considered the Murray natives superior to those near Adelaide, and those living outside the Bunda Plateau were superior to those living within its confines, who were very thin in the body and had narrow and elongated heads. He mentioned several distinguishing peculiarities in the natives of the Bunda region, which perhaps were due to the great privations which they underwent. They partly obtained their subsistence by digging out the great wombats, and it sometimes occupied them several days in digging out a single burrow. The natives used a pointed stick for digging with, and a stick also tipped with flint for killing the wombats. They did not appear to be capable of hunting the kangaroo, and did not use a throwing-stick, as do the natives to the eastward about Fowler's Bay. The natives arrived at maturity very early, and the women were old at thirty. The skull from the Bunda region, which he produced, compared very unfavourably with those of the Murray tribes.

The Hon. B. T. FINNISS asked if the Professor had noticed whether the incisor teeth were like molars?

Professor TATE, in reply, referred to the skull of a Eucla native, in which the incisor teeth had broadish crowns.

Mr. CHAS. TODD spoke of the value of the paper, and thought that at some future time Professor Tate might be able to offer some observations upon the springs extending almost up to Charlotte Waters. He understood that the longest drought made no difference in those springs, so they must have a strong source somewhere. From the MacDonnell Ranges the watercourses were of considerable length. With regard to the Bunda region, it had been Professor Tate's interest and anxiety to find water, and, in spite of his bad success, he could not but admire the ability and enterprise he had brought to bear upon the work.

The Hon. B. T. FINNISS read a paper upon "Will: the Effect of Physical Forces acting on the Brain," in which he referred to various theories on the subject, quoting largely from standard authors, and treating upon materialism and transcendentalism.

A very short discussion ensued.

ORDINARY MEETING, JULY

Professor R. TATE, F.G.S., President, i

The HON. SECRETARY laid upon the tab

"Entomological Society's Transactions

"Proceedings of the Linnean Society,"

"Proceedings of the Numismatic and A Philadelphia.

"Native Plants of Victoria Succinctly Ferdinand von Mueller.

"Observations at the Adelaide Observa

In asking for the usual vote of thank marked upon the great value of such wor

The HON. SECRETARY read a letter fro South Australian Institute, stating that agreed to recommend that a subsidy of p the subscriptions to this Society should l the sum granted to Institute.

The HON. SECRETARY read a reply from t to a recommendation forwarded by the Pl January 7, 1879. Whilst acknowledgi the subject indicated in the recommend viewing with pleasure the fact that the I Professor Tate entertained the opinion th not be required for the accomplishment c tion, the Council of the University reques tively small number of subjects" might b desired that the Council should add to i as to be informed of the arrangements could, without additional expenditure, study which the Philosophical Society blished.

The HON. SECRETARY submitted a dra the University Council, as follows:—

"Adelaide Ph

"To Wm. Barlow, Esq., Registrar of the Adelaide University.

"Sir—Your letter of the 31st May, referrin suggested course of study for the training of Mi the Adelaide Philosophical Society and forwarde January last, has been considered by the Socie draw your attention to the following points:—

"1. The Society did not affirm that the intelligent application of science to the process treating the ores'—could be attained without a but suggested that, 'as the curriculum of the Un several branches of knowledge bearing upon t might, by the addition of a comparatively small n for a course of study which would greatly advan

would, by giving prominence to the importance of the subject, pave the way for a more comprehensive scheme.'

"2. The branches of study specially needed for the training of the Mining Engineer, and already included in the University course, are as follow:—

(a.) Mathematics (pure), including geometry and trigonometry as far as the solution of triangles.

(b.) Mathematics (applied), including statics, hydrostatics, kinetics, and physics (especially heat).

(c.) Mineralogy.

(d.) Geology.

(e.) Chemistry, including the classifications and characters of metals, and the chief applications of chemistry in the arts and manufactures.

(f.) Practical chemistry, including the analysis of ores.

"3. The additional branches of study, which, in the opinion of the Philosophical Society, should supplement the above are as follow:—

(g.) The application of *(a.)* to mechanical drawing and surveying.

(h) The application of *(b)* to the methods of mining and to the mechanics of the steam-engine and pumping and dressing machinery.

"4. It will be seen that the extra subjects are comparatively few in number, and consist in the practical application of subjects already taught.

"They are for the most part comprised in the course of training defined in the University calendar for candidates for the Angas Engineering Scholarship, who have (under clause 4 of the regulations) to pass an examination in mechanics and drawing, and such other subjects as the Council of the University shall from time to time direct, and must (under clause 6) have passed, to the satisfaction of the Council of the University, through such courses of special studies and practical training as shall from time to time be prescribed by the statutes or regulations of the University."

Reply approved.

The PRESIDENT read portion of a private letter which he had received from the Hon. L. Macleay, of Sydney, in which he stated that he approved highly of a suggestion made by Professor Tate that a congress of science workers should be held during the International Exhibition, and that annual meetings might be arranged for in the various colonies on the principle of the British Association. He would prefer the Association to include all the sciences coming under the term natural history, grouped as follows:—First section, anthropology, ethnology, and philology; second section, zoology and botany; third section, geology, geography, and meteorology; fourth section, medical science. He hoped that Professor Tate would be present in Sydney to assist at the opening of the Exhibition and to originate and organise the "Australian Association for the Promotion of Science."

A short discussion ensued, during which comparisons were instituted between the various colonies in the matter of scentific inquiry, and in which New South Wales and New Zealand were very favourably mentioned.

The PRESIDENT, with respect to objects and drawings shown at the Society's meetings, expressed the opinion that the exhi-

bitor had a sort of copyright over them, and without his consent they should not be made public. He mentioned a letter which accompanied some drawings of butterflies, in which the exhibitor asked that they might not be copied, and remarked that it would be a breach of etiquette to copy such drawings without the consent of the contributor. He then placed the drawings alluded to upon the table, as well as some fossils received from Mr. J. G. O. Tepper, of Ardrossan, amongst the latter being the head of a Tribolite *(Olenus)*, which Professor Tate pronounced to be an undoubted evidence of the Lower Silurian origin of the rock from which it was taken.

The Hon. Secretary read a paper entitled "A Census of the Insect Fauna of South Australia," by O. Tepper (see page 33).

A discussion followed, during which Professor Tate said Mr. Tepper had shown wonderful industry and observation in his researches, and had made himself acquainted with the habits of the insects in a way that showed how entomology could be made of practical benefit. A good many people looked upon beetle and butterfly collecting as a ridiculous pursuit, on a par with the accumulation of old china; but when timber gets destroyed and other ravages were committed the knowledge of the entomologist was sought for as valuable. Reference was also made by members to various insects from abroad which had become acclimatised, amongst which was the curculio (*Otiorhynchus meridionalis* ?) attacking the bark, leaves, and tender shoots of shrubs and trees.

Ordinary Meeting, August 5, 1879.

Professor R. Tate, F.G.S., President, in the chair.

Baron Ferdinand von Mueller, K.C.M.G., F.R.S., &c., and George French Angas, F.L.S., Corr. Memb. Zool. Soc., were elected honorary members.

William Russell, of Port Adelaide, was elected an ordinary member.

The Hon. Secretary read a letter from the Committee of Council of Adelaide University, in answer to letter from the Adelaide Philosophical Society of July 1, 1879, *re* mining engineering, reiterating the opinion that the proposed addition to the curriculum would entail an expense which the University Council would not be justified at present in incurring. He also stated that an acknowledgment of its receipt had been forwarded.

Professor Tate gave notice of motion for next meeting, as follows:—"That in the event of the Board of Governors of the Institute being called upon to decide upon the question of opening the Museum on Sunday afternoons, this Society

requests its representative to vote in favor of throwing open the Museum on Sundays."

Mr. T. Cloud, of Wallaroo Smelting Works, produced a number of specimens of wash-dirt from the Bingara diamond field of New South Wales, given him by Mr. A. Liversedge, Professor of Geology and Mineralogy, University of Sydney. He stated that they were specimens of bed-rock, upon which drift occurred. The drift was only a few feet in depth, and was represented in different parts of the district by the specimens laid on the table. The process of extracting seemed to consist of putting the stuff in a machine to separate the clay and small pebbles, and the diamonds were separated by one of Hunt's diamond machines. The gems, stones, &c., accompanying the diamond were tourmaline, or jet stone, occurring as rolled prisms; zircon; sapphire, generally in small angular pieces, usually of a pale colour; topaz, in rounded fragments; garnet, in small rough ill-formed crystals; spinelle, not common; quartz, in small prisms; brookite, very rare; titaniferous iron, common; magnetic iron in small prisms; wood tin, rare; gold and osmiridium, rare. The diamonds were small, some clear, colourless, and transparent, others a pale straw colour. One or two very small dark ones were found, also some of a greenish hue.

Mr. Cloud also produced a piece of atacamite found in the flues of the Wallaroo Smelting Works. (See p. 80.) He also showed a double sulphide of copper and iron crystallised, corresponding in chemical constitution and crystalline character with the natural product (Borell) which had been found in the copper furnaces.

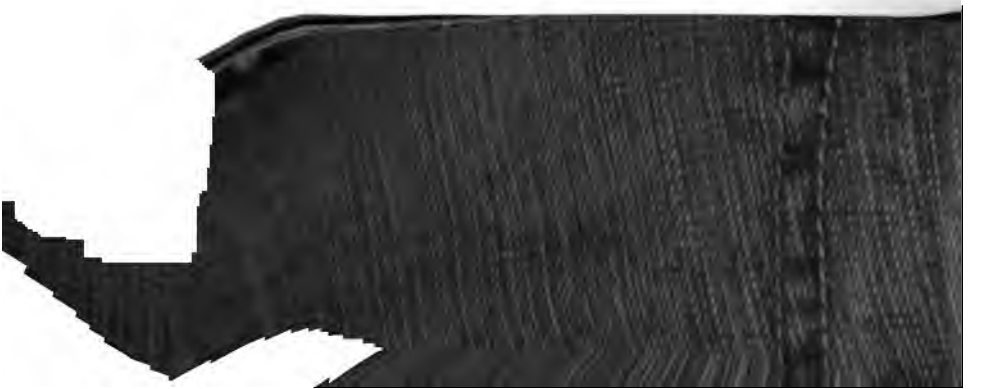
The Rev. J. E. T. Woods' paper on "Australian Starfishes" was taken as read. (See page 89.)

Dr. J. F. Joyce read a paper on "Sunstroke," in which he explained the various symptoms attending an attack, and recommended several simple remedies, as well as precautionary measures, such as avoidance of exposure to the sun, abstinence from alcoholic liquors, and the use of a damp cloth in the hat when working in the sun.

Dr. S. J. Magarey mentioned the fact that decomposition set in very rapidly in cases where death resulted from sunstroke.

Professor Tate remarked that a confirmation of Dr. Magarey's statement existed in the fact that collectors, who frequently killed animals by tying them in the sun with their heads immovable, were compelled to remove the skins speedily, as decomposition soon ensued.

Mr. Ebenezer Cooke, M.P., read a paper "On the Museums in Australia and New Zealand," in which he pointed out the



value of such institutions in creating a refined taste
classes, exciting the interest of youth, extending their k
ledge, and directing their studies. He also expatiated upo
splendid Museums of different cities in the world, contra
them with that of South Australia, and condemned the c
parative indifference to intellectual cultivation therein in
cated. He described the Sydney Museum, its extensive colle
tions, and the varied character of its contents; also the magn
ficent Melbourne Museum, which he said was about six times
as large as ours, and held within its walls almost every form
of creation- raw material of every kind, shells, models of
containing a vast number of samples of stone, woods, manufac-
tured and products of all sorts, whereby men of every
machinery, and calling could find something to instruct or
class, trade, or amuse them. In addition to that was the Technological Museum,
amuse them. In addition to that was the Technological Museum,
8,000, and he questioned whether our Museum attracted 1,000
on that day. In answer to the oft-repeated argument that
it was not fair to compare our colony with its more wealthy
neighbour, he instanced the Museums of the smaller colonies
of Queensland and New Zealand, which all exceeded ours in
every way. He closed by referring to his own action in Parlia-
ment with respect to the Museum, and expressed himself
strongly on the subject of making proper provision. The past,
he said, had been so barren of results, and the future seemed
so intangible, that the matter should be taken up without delay.
The other colonies were very far in advance of us; collections
of great value were being lost to us, on account of people who
could give specimens to the Museum becoming disgusted and
discouraged; the specimens already in our possession were
many of them stowed away for want of room; the present
space was so limited that immediate enlargement was necessary,
and there were other potent reasons why something should be
done in the way of providing a Museum worthy of the reputa-
tion and importance of the colony. He mentioned instances
where valuable historical collections had been lost to Adelaide
for want of a place to put them in; and after expatiating upon
their importance, expressed the opinion that if the Museum had
been put under a distinct Board of Governors it would have
attained a degree of importance far above that which it at
present occupied. In respect to the proposed new Institute
building, he remarked that the Museum even then would not
by any means compare in size with that of the crowded one:
Christchurch. The Museum, he thought, might be conne
with the Botanic Garden. In the past we had been
going to do something great, and never did it, and no-
so blinded with the brilliancy of what we were goi-

we were still doing nothing, and he desired to urge the necessity of some action in the interests of the community at large.

Mr. MAGAREY pointed out that the Tasmanian Museum was thirty years older than ours; the building was put up economically; and in Sydney the fine structure was obtained under favourable circumstances. In New Zealand the Museum was not an expensive one He believed that the one in Christchurch was of wood.

Mr. COOKE said he thought that those of Christchurch and Dunedin were of stone.

Mr. MAGAREY said Mr. Cooke's arguments were sufficiently good to stand without his making unfavourable comparisons.

Professor TATE referred the meeting to his own remarks on a former occasion when he dealt with the question of the value of Museums, and that of our Museum not fulfilling its proper functions—viz., in the way of accommodation and in other respects. The Museum might be in connection with the University. The Curator was hampered, and had not the liberty of buying on his own responsibility good specimens which were often placed in his way. The Council of the University were liberal to him (Professor Tate), and he trusted that the Museum connected with the University would be one which the colony could be proud of; he intended to do his utmost to make it so. New Zealand as a scientific colony ranked high, and had a foremost place amongst the British colonies. The scientific men connected with it were of world-wide reputation.

Mr. CHAPPLE suggested that some temporary building might be provided, so that collections might not be lost. The matter was very pressing, and something should be done, even if it were only to put up a weatherboard building for the exhibition of valuable specimens.

Professor TATE remarked that the tendency here appeared to be to spend all the money on the outside and starve the interior. If £20,000 were put at the disposal of some practical gentlemen they would put up a building that would last 100 years and serve its purpose well.

ORDINARY MEETING, SEPTEMBER 2, 1879.

Professor R. TATE, President, in the chair.

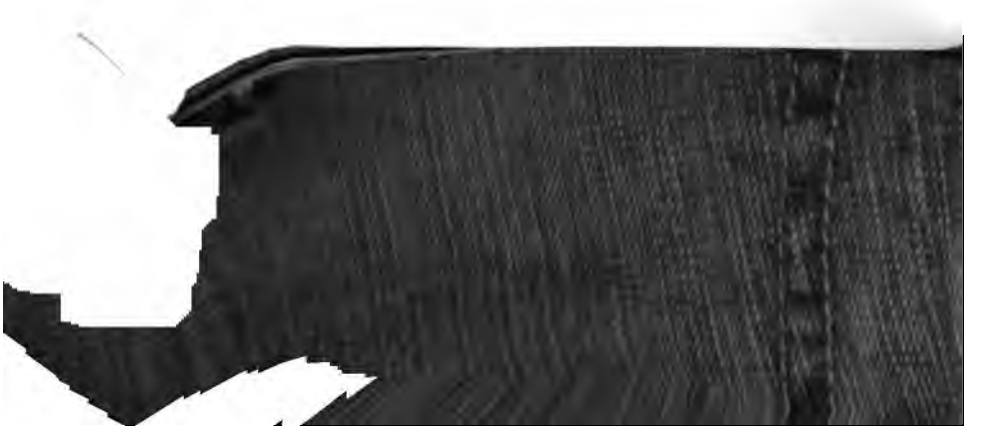
The HON. SECRETARY laid upon the table:—

"Observations at the Adelaide Observatory for December, 1878."

"Results of Observations in Meteorology, &c., in Melbourne." By R. J. Ellery, F.R.S. Vol. V.

"Eucalyptographia," first and second Decades. By Baron Ferdinand von Mueller.

J. W. Billiatt was elected an ordinary member.



Dr. Gosse said that this being the first occasion on which he had been enabled to attend the meetings of the Society since the delivery of the President's inaugural address in October last, he wished to correct a few errors into which the Professor had probably been inadvertently led, and which he was sure the Professor would correct as soon as he was convinced of his error. The first was with respect to the space which would be available for Museum purposes in the proposed new Institute building, which, instead of being inferior in area to that at present possessed by the Museum, would be greatly increased. The second point was with regard to the management, which the Professor had found fault with, but he directed attention to the annual reports, in which the requirements of the Museum had been urged without ceasing.

Mr. R. Rees supported the remarks made by Dr. Gosse in a lengthy speech, in which he mentioned that the space devoted to the Museum in the new building would be 200 feet long by 55 feet wide and 44 feet high.

Mr. C. Todd, C.M.G., supported, stating that with respect to the purchase of specimens the Governors had never opposed any purchases recommended by the Curator. He mentioned the entomological collection made by the late Mr. Odewahn, of Gawler, and stated that it was not purchased because it had been reported upon by the Curator as not being of any great value to the Museum.

Professor Tate admitted that he might have been misled as to the space available for the Museum, but asked if the whole of the space mentioned by the previous speakers would be at once placed at the disposal of the Curator, or whether it was not the fact that a small portion only would be set apart, and the remainder of the accommodation relegated to the distant future, when the whole of the proposed building should be completed? He had made no attack upon the governing body of the Institute, but only spoke in the interests of the Museum, and really addressed his remarks to the Government and to the public. He considered the specimens in the Museum were badly displayed, and possessed no educational value; but he had not asserted that the Museum was badly managed. His aim had been to show that there had not been such a display of the specimens as might have been wished, even with the space available. He denied that the public could derive instruction, and as a professional Curator he stated that they could be better arranged. He mentioned the fact that there was no mineralogical collection available for transmission to the Sydney Exhibition, and that collectors were now engaged in the work of gathering specimens.

Dr. Gosse said, with respect to a diamond mentioned by

Professor Tate as having been offered to the Museum for £8, that no such offer had been made to the Governors.

Canon Farr rose to supplement the observations made by the previous speaker, but was checked by the President after making a few remarks, in which he stated that the space available in the first section of the new building would be 70 x 40 feet, with a gallery 156 feet long, giving a total area of 4,672 feet.

Dr. Magarey characterised the discussion as irregular and against the rules. He said that it was undignified for four of the Governors to take up the time of the meeting in attacking the President. The Philosophical Society was not bound by the opinions and utterances of its President. He thought the Professor's remarks would do more good for the Museum than anything the Governors had ever done, and that they might justly claim him as being on their side.

Professor Tate said he had allowed the discussion to proceed, although very irregular, because if he had checked it it might have been thought that he was desirous of escaping any censure which might be considered to be levelled at him.

After a few further remarks the discussion closed.

In the absence of the Hon. Secretary, Mr. Thos. D. Smeaton read "A Census of South Australian Insects. Part II." By J. G. O. Tepper (see page 33).

Professor Tate read a paper on "The Newer Tertiaries of Munno Para, and the Water-bearing Capabilities of the Adelaide Plains." By Gavin D. Scoular (see p. 60).

The following papers were taken as read :—

"Recent and Fossil Species of Australian Salenariadæ." By J. E. T. Woods.*

"Zoologica et Palæontologica Miscellanea." By Prof. R. Tate. (See page 129.)

"Note on the Artificial Formation of Atacamite." By J. T. Cloud. (See page 80.)

Annual Meeting, October 7, 1879.

Professor R. Tate, F.G.S., President, in the chair.

The Hon. Secretary laid upon the table—"South Australian Aboriginal Folk-lore," from the MSS. of the late Rev. G. Taplin, published by the Government of South Australia; "Meteorological Observations of the Summer, Winter, and Spring of 1878-9, taken in England," by C. L. Wragge, F.R.G.S.

Professor Tate read his President's annual address on "Outlines of South Australian Geology." (See page xxxix.)

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* The publication of this paper is unavoidably postponed.

The Hon. Secretary read the Annual Report and Balance-sheet. (See page xxxvi.)

The following gentlemen were elected as officers and Council for the ensuing year:—

President—Professor R. Tate, F.G.S.

Vice-Presidents—Chas. Todd, C.M.G., F.R.A.S., M.S.T.E., and Fredk. Chapple, B.A., B.Sc.

Hon. Treasurer—Thos. D. Smeaton.

Hon. Secretary—Walter Rutt, C.E.

Council (in addition to above)—J. C. Verco, M.D.; S. J. Magarey, M.B.; D. B. Adamson, R. Hickson, M.I.C.E.

Votes of thanks were accorded to the officers for the past year.

REPORT OF THE COUNCIL

OF THE

ADELAIDE PHILOSOPHICAL SOCIETY,

FOR THE YEAR ENDING SEPTEMBER 30TH, 1879.

The Council has the satisfaction of stating that the useful work of the past year is at least equal to that recorded of any previous year in its history.

The following papers were laid before the Society during the year:—"Our Climate and Infant Mortality," by S. J. Magarey, M.B.; "The Philosophy of Consciousness," by Hon. B. T. Finniss; "The Aborigines of South Australia," by J. D. Woods; "Statistics of Consumption in South Australia," by J. C. Verco, M.D.; "The Rocks and Cliffs at Ardrossan," by O. Tepper; "The Physical Features and Natural History of the Country around the Great Bight," by Prof. Ralph Tate, F.G.S.; "Will: the Effect of Physical Forces acting on the Brain," by Hon. B. T. Finniss; "Census of the Insect Fauna of South Australia, Part I," by O. Tepper; "List of Australian Starfishes," by Rev. J. E. T. Woods, F.L.S., F.G.S., &c.; "Sunstroke," by J. F. Joyce, M.D.; "Museums in Australia and New Zealand," by E. Cooke, M.P.; "Census of the Insect Fauna of South Australia, Part II," by O. Tepper; "The Newer Tertiaries of Munno Para," by Gavin Scoular; "Recent and Fossil Species of Australian Salenariadæ," by Rev. J. E. T. Woods, F.L.S., F.G.S., &c.; "Zoologica et Palæontologica Miscellanea," by Prof. Ralph Tate, F.G.S.; "Note on the Artificial Formation of Atacamite," by J. F. Cloud, F.C.S.

The Council has felt that the Society was not obtaining from its affiliation to the South Australian Institute all the advantages which had been intended by the Legislature to attend such a connection, and has represented to the Government that although the Institute Act provides that the affiliated Societies may share in the moneys provided for Institute purposes by the annual vote of Parliament, the estimates were worded in such a manner that they were precluded from the enjoyment of this privilege. The Government has acknowledged the justice of the representation, and the wording of the estimates, as passed this session, places the affiliated Societies on the

same footing as country Institutes, the subscriptions to which are subsidised by the Government at the rate of pound per pound. The augmented income which will result from this decision will enable the Council to fulfil the hope expressed in their last report, and to publish the transactions and proceedings annually, and in a more complete form than was possible in the volume for 1877-78. The transactions, being forwarded to the leading scientific Societies of the world, afford an opportunity of putting before students facts in connection with the natural history of this Province, which, though very valuable, would otherwise be lost. The Council therefore urges upon all the members that they should place upon record their own observations and such as may come under their notice by communicating them in the form of papers or memoranda to the Society. A correspondence has taken place between the Society and the Council of the Adelaide University, in which the Society urged upon the Council the advisableness of adding to the University curriculum lectures upon the practical application to the profession of mining engineering, of the subjects already included in the course of study as laid down in the University Calendar, with the object of inducing the more scientific, and therefore the more economic, development of the mineral resources of the Province. The University Council has acknowledged the importance of the subject, but, after a long consideration of the Society's suggestions, has come to the conclusion that financial considerations must prevent any steps being taken in this direction at present. Death has again removed from our midst one of our oldest members. Mr. Benjamin Herschel Babbage, C.E., may almost be considered to have been one of the founders of the Society, having joined it on 17th January, 1853, one week after its formation. He has throughout taken a deep interest in the Society's work, and has several times held the office of Vice-President. There has been during the year an increase of six in the membership of the Society. This is a matter for congratulation, but the Council feel that there are many gentlemen in the Province who are interested in the progress of science, and who might materially advance the same by connecting themselves with this Society, whose names do not appear on our roll. They also regret that only two young men, and no ladies, have availed themselves of the advantages held out by the recently adopted rule forming the class of associates. In conclusion, the Council expressed a hope that their successors may receive the support of every member, and that the progress which has characterised the Society during the last two years may continued in the future.

THE TREASURER IN ACCOUNT CURRENT WITH THE ADELAIDE PHILOSOPHICAL SOCIETY.

Dr	£	s.	d.
October, 1878.			
To Balance	124	15	2
Subscriptions	118	2	0
Transactions and extra copies of Papers sold...	2	5	0
	£245	2	2
Balance brought down	£127	15	7

Cr.	£	s.	d.
By Contribution to S. A. Institute	12	0	0
Printing Transactions	55	13	0
Do. Circulars	11	12	6
Advertising	13	13	0
Postage and Sundries	4	2	10
Commission collecting Subscriptions ...	5	11	8
Assistant Secretary's Salary	12	12	0
Do., sending out Transactions	2	2	0
Balance	127	15	7
	£245	2	2

Audited and found correct,

4th October, 1879.

E. PARISS NESBIT,
Auditor.

THOMAS D. SMEATON.
Treasurer.

The Anniversary Address of the President,

Professor Ralph Tate, Assoc. Lin. Soc., F.G.S.

Prefatory.—At our last Anniversary, when I had the honour of addressing you from this chair, I took occasion to sketch the present state of our knowledge of the Natural History of South Australia. But as that retrospect does not embrace Geology, beyond indicating the chief published sources of our information, and directing attention to the salient points of our geology about which accurate observations are needed, I propose, now, to supply the omission. I shall, however, pursue a somewhat different plan in dealing with the Geology than I did with the other branches of Natural History, and instead of a mere review of what has been published on the subject, I will incorporate all the information that I have acquired by personal observation and by correspondence with what has been written. In this endeavour I hope to present you with a more systematic and fairly comprehensive history of the geological changes that this land of ours has undergone than it would otherwise be possible. An attempt of the kind was made by me in a course of lectures on "The Ancient Physical Geography and Geology of South Australia," delivered during the winter of 1877 under the auspices of the University of Adelaide.

The following Syllabus is a reprint, as advertised :—

Lecture I.—April 9th.

Educational value and objects of Geological Science.

Geological preliminaries, embracing the origin and phenomena of igneous and sedimentary rocks, and the classification of sedimentary rocks.

Surface features of South Australia. Coast scenery, and its relation to rock structure.

Lecture II.—April 16th.

The origin and characteristics of our shingle beaches and sand dunes—The Coorong and Murray bar.

Nature and origin of alluvial plains. The Biscuit Flat and its characteristics.

Lecture III.—April 23rd.

South Australia slowly rising: its ancient sea margins. Raised beaches of Victor Harbour, Aldinga, Brighton, Yorke's Peninsula, &c. Recent marine limestone and other deposits of Dry Creek, Glenelg, Edithburgh, Victor Harbour, Lacepede Bay, &c. Contemporaneous sandhills of Plympton, Alberton, and Cape Northumberland.

Distribution of marine life in depth.

LECTURE IV.—April 30th.

The plains of Adelaide, Willunga, &c., the beds of deserted lakes. General character of their deposits, and of the auriferous drifts. Are we drying up? The erosive action of rivers; the recession of the Wannon Falls. The origin of the gorge of the River Murray, and proofs of a former lake-expansion of the Murray waters over the Murray plateau.

Nature and origin of the white limestone of Adelaide.

LECTURE V.—May 7th.

The origin of our salt lagoons and of the brackish waters of our wells. Lake Torrens—an arm of Spencer's Gulf, or a salt lagoon? Underground drainage in the South-Eastern Districts. The Adelaide hills once enveloped in perpetual snow: the ice-worn aspect, and other evidences of glacial action. Ice-borne granitic blocks on Yorke's Peninsula; ice scratches in the valley of the Inman.

LECTURE VI.—May 14th.

The extinct gigantic animals of the Pliocene period, and their relationship to the existing fauna.

Retrospect. The subsequent climatic changes which gave rise to the present order of things. The extinction of the large animals.

The volcanoes of the South-east; proofs of their comparative recentness. Distribution of volcanic material beyond the present volcanic centres.

LECTURES VII. and VIII.—May 21st and May 28th.

South Australia an archipelago during the Miocene period. The rocks of the period, as exhibited in the cliffs of Aldinga Bay, Yorke's Peninsula, the River Murray, &c. The origin of the sediments constituting the same.

The littoral character of the deposits at Gawler, Morphett Vale, Lake Torrens, &c.

The semi-tropical character of the marine productions of the period—colossal sharks, carnivorous whales, &c. The relation of the fauna to recent and past periods.

Deep-sea soundings, and life off the Australian shores.

LECTURE IX.—June 18th.

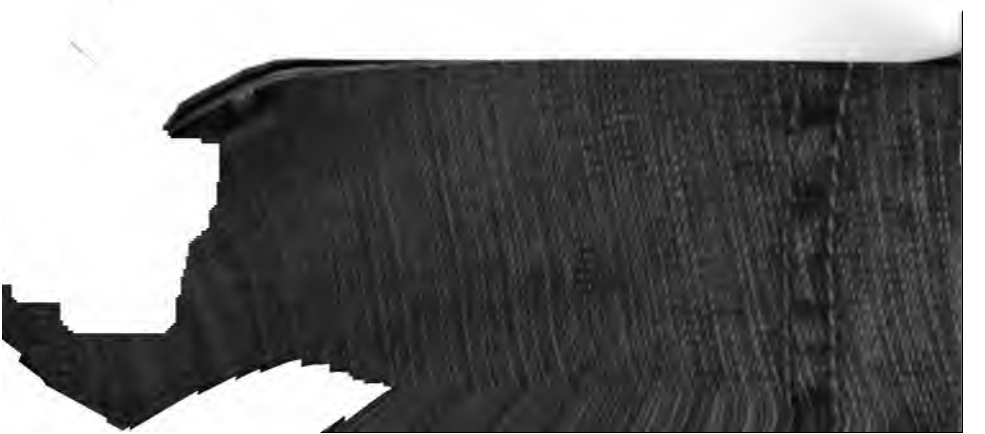
Jurassic formation of the interior.

The geological structure of the Adelaide hills; two distinct sets of strata—the older and metalliferous, the younger and non-metalliferous. The ancient volcanoes of the Adelaide hills, and their association with the gold and copper bearing rocks.

LECTURE X.—June 25th.

On the probable presence of true coal in South Australia; and on the relative ages of true coal and lignites. Nature and origin of the substance called "Coorongite."

As most of the facts, then communicated, were chiefly acquired by personal observation, extending over the brief period of fifteen months, I doubted whether my generalizations about such a vast and unexplored region as South Australia would not require considerable modification as the result of more extended observation. This fear restrained me from publishing the lectures; but having greatly extended the area of observation, and having been assisted by other workers, in the interval of more than two years, which has elapsed since the delivery of the lectures, I present you with more confidence these "Outlines of South Australian Geology," which are, however, based on them. The interest that is shown for



the subject will justify the issue of the "Outlines," despite that imperfection which inevitably belongs to it as a pioneer work. To conclude these introductory remarks, I may state that the field of unexplored facts is so vast that there is ample room for an army of workers, acting independently and for many years to come. If amateurs would only give to the Society what they know of the geology of particular localities in their neighbourhood, we should make a great advance towards a complete geological history of the colony. I owe to not a few in the Far North, on the Murray, in the South-East, and elsewhere hearty thanks for their active co-operation in my geological investigations, and for the promise of future help. That there are men, who are not altogether absorbed in money-getting, able and willing to add to our stock of knowledge, I have good reason for saying.

LEADING PHYSICAL FEATURES OF SOUTH AUSTRALIA.

If we inspect the map of South Australia proper, we observe that the mountain ranges follow the general direction of the two Gulfs, St. Vincent's and Spencer. The elevated regions of the southern part of the Province occupy three well-defined areas, separated from each other by the gulfs mentioned; but in their northerly extension they approach each other, and to the north of Lake Torrens no well-defined mountain system obtains. Our ranges are rather of a composite character, consisting of parallel ridges, often separated by broad and deep plain-like valleys; this feature is most prominent to the north of Kooringa.

The first group is that of the Adelaide chain, which commences at Cape Jervis and occupies the coast line to the north as far as Normanville, and to the east as far as Port Elliot, and continues with varied height in a nearly north direction to beyond Lake Frome, a distance of 350 miles. It attains its greatest elevation in the Mount Lofty and Barossa districts, and its chief highest points are Mount Lofty, 2,334; Kaiserstuhl, 1,973; Lagoon Hill, 2,235; and north of Burra Burra, Mount Cone, 2,601; Razorback, 2,834. It is very little interrupted in its course, and that only by a few narrow gorges through which are discharged our insignificant rivers, emptying themselves into St. Vincent's Gulf. Two spurs are thrown off on its western side within our immediate district, one terminating in the sea cliffs between Marino and Morphett Vale, and the second in those forming the southern boundary of Aldinga Bay.

The second group is that of the Flinder's Range, which commences in the elevated land of Northern Yorke's Peninsula,

but more prominently in the conspicuous hills termed the Hummocks at the Head of St. Vincent's Gulf, thence it follows a curvilinear line with a general northerly direction to round the head of Lake Torrens. The east coast of Spencer's Gulf and Lake Torrens has the same general direction as this chain, and to which it is in close proximity; and also because of the small annual rainfall, about 12 inches, though the elevation of the range is higher than that of the Adelaide chain, the rivers are all short, and for the most part do not reach the sea or Lake Torrens. The highest points in this range are among the highest in South Australia. They are—the Bluff, 2,404; Mount Remarkable and Mount Brown, about 3,000 feet.

The third elevated region is that of Eyre's Peninsula, which does not seem to present any well-defined system. However, the Gawler Ranges, on its north, are represented on our maps as having an east and west strike; and the high grounds about Port Lincoln seem to have a north and south trend; but to the westward, certainly as far as Streaky Bay, the generally undulating country is dotted over by isolated peaks, or short razor-backed ridges showing no uniformity as to direction.

All these elevated regions are constituted of the fundamental rocks and their associated granites.

The Adelaide chain is bounded on its western side by the vast and fertile plain of Adelaide, which extends from Marino, on the south, and sweeps round the head of St. Vincent's Gulf on the north. No inconsiderable portion has been removed by the action of the sea, as it is abruptly terminated on the shores of Holdfast Bay and at Ardrossan on either side of the Gulf. The period of its formation is comparatively recent. Plains of a like character are interspersed in longitudinal bands among the parallel ridges of the Flinders Range and northern extension of the Adelaide chain, though not one is equal in magnitude to the Adelaide Plain. The two southern spurs of the Adelaide chain enclose undulating plains, in part partaking of the character of the Adelaide Plain, but mainly constituted of rocks of much older, though of Tertiary date; the northern one is the Willunga Plain, the southern is the Myponga Flat.

On the eastern side of the Adelaide chain there stretches far and wide the Plain of the South-East, towards the western boundary of which flows the Lower Murray. The dimensions of this plain are about 290 miles from north to south and an average of 100 miles from east to west. The general level, which is broken by low sandy ridges, does not exceed 200 feet. The rocks composing it are of the same age as those composing the Willunga Plain and the lower tracts of Yorke's Peninsula. The prevailing uniformity of scenery is relieved in two limited areas by isolated conical hills of granitic and of volcanic

materials; and towards the seaward margin by immense swamps. No rivers originate in this plain, though a few short ones traverse its western margin in their passage from the Adelaide chain to the River Murray.

To the north and west from Lake Torrens there stretch almost unlimitable plains, somewhat similar in their character to portions of the S.E. Plain. The western section is probably coterminous with the Bunda Plateau, around the head of the Great Australian Bight.

Jukes (1846), Burr (1846), and other early geological observers recognised these leading surface features of the province, and relegated the strata of the hill ranges to the Palæozoic and metamorphic series, and the fossiliferous beds constituting the plains to the Tertiary epoch.

Pre-Silurian.

Burr, occupying himself with the geological structure of the country between Mount Arden and the South coast, and eastwards of the meridian of Mount Arden, has given us a sketch of the sequence of the strata of these ranges. He notes their southerly dip, and considers them, probably, to correspond with the Cambrian and Skiddaw systems of Sedgwick, having been led to this belief from the circumstance of there being no fossils in them. In his generalised section of the arrangement of these old rocks he has not attempted to give thicknesses; and it appears to me that he has inverted the true order. In an ascending series he represents it as follows:—

1. Quartzose sandstone.
2. Dark-coloured slate.
3. Limestone beds, frequently very impure, and passing into
4. Slate and slaty beds (metalliferous).
5. Mica slate, chlorite slate, and thence frequently into sandstone (metalliferous).
6. Gneiss, which is metalliferous, resting on
7. Unstratified granite, and other igneous rocks.

The strata composing the principal range of South Australia have a general dip to the south-east, and show a succession of clay slate with quartzite bands, crystalline limestones, mica slate and other decidedly metamorphic rocks, and granite. It is remarkable that the apparently less metamorphosed strata occupy the lowest position, whilst the uppermost stratum is gneiss, unless we regard the granite, which follows next, in the light of the extreme of alteration of which the gneiss is an earlier phase. That the highly metamorphic rocks do not form the axis of the Adelaide chain is beyond dispute. And in various traverses across the strike of the strata of our hills I have failed to detect faults or inversion, which would account for their exceptional position, whilst, on the contrary,

the successional arrangement is sufficiently clear to leave little room for question.

These rocks are the chief repositories of our mineral wealth, including ores of copper, lead, silver, bismuth, iron, and gold. They exhibit little disturbance, and the absence of faults is noteworthy; however, along the line of the anticline, from Hallett's Cove to the Stockade, and along the Gawler hills, well marked examples of highly contorted strata are to be seen.

Mr. Selwyn has given an approximate measure of the thickness of the strata in the Cape Jervis promontory between Normanville and Encounter Bay. He states that "the dip of the beds appears to be very regularly and constantly to the south-east, at an average angle of not less than 30 degrees, and consequently, unless some very extensive faults occur—of which I could see no evidence—there is a constantly ascending series, exposing a vertical thickness of nearly 30,000 feet of strata." In this connection Mr. Selwyn records an observation that is confirmatory of my opinion of the prevailing superposition of the mica slate and gneiss:—"From the *highly metamorphic character* of nearly the whole of these rocks, and particularly of *those portions that*, from the dips, would *appear to be the highest beds of the series*, it is often exceedingly difficult to determine whether the dip observed is really that of the beds, or only that of the cleavage." There cannot be a doubt that the thickness of these fundamental rocks is much greater in those portions of the central chain near Adelaide than in the Cape Jervis promontory; indeed, Mr. Scoular has led us to infer that 90,000 feet in vertical measure are displayed in the South Para river, and that this thickness is not a moiety of the whole; and I trust that our curiosity in this particular will soon be satisfied by the publication of an extended horizontal section from the Gawler Plains eastward, which, we know, our zealous corresponding member has long been engaged in preparing.

Mr. Selwyn was at first inclined to the opinion that the slaty rocks, which underlay unconformably the sandstones, purple and grey shales, and siliceo-calcareous beds which occupy the whole country from Mount Remarkable and Port Augusta, north-east of Mount Serle, belonged to a superior set of beds than those which occupy the whole of the country to the south; but he afterwards thought "it just possible that no such natural divisions exist in the rocks of the South Australian chain, and that the difference in general mineral and lithological characters observed between the northern and southern rocks is entirely due to metamorphic influence." In the absence of fossil evidence that geologist hesitates to ex-

press any opinion, either as to the probable age or even superposition of the various rock masses forming the central mountain chain of South Australia; but, nevertheless, has stated that "the only locality in which the rocks of that chain bear any decided resemblance in mineral and physical structure to the auriferous Silurian rocks of Victoria is in the valley of the Onkaparinga; and, consequently, I was at first inclined to suppose that all those rocks that are doubtless higher in the series—including the crystalline limestones of Finniss Vale, Macclesfield, Mount Torrens, Keyne's Hill, Angaston, and the Burra—were altogether newer than Silurian. Now, however, I am inclined to think that this view is probably erroneous, and that they are all true Silurian rocks. At all events the difference in mineral character is no greater than exists between the slaty lower Silurian rocks of Wales and the siliceous limestone, gneiss, and quartz rocks of the same formation in the Northern Highlands of Scotland. . . . I was much struck with the remarkable accordance in lithological character and general sequence of the siliceous limestones, quartz rocks, and micaceous flagstones of the Durness and Assynt Silurians, with that of the siliceous limestones, quartzose sandstones, and micaceous slates and flags of the northern part of the South Australian chain; and I have little doubt, though rare and not easily detected, that fossils will eventually be found in some portion of the latter, as they have been in the Durness and Assynt limestones, that will enable them to be at once assigned their true position in the geological scale."

According to the Rev. J. E. Tenison Woods (Geol. Obser. in S. A., pp. 20, 21) fossils have been found at two portions of the Adelaide chain—at Willunga thirty miles south, and at Nuriootpa, forty-seven miles north from Adelaide. At the former locality it was reported to him that *Pentamerus oblongus* had been found; but from the latter, a fossil which had been collected by his brother has been recognised by the Rev. J. E. T. Woods as *Cruziana cucurbita*—a species of algæ described from the Silurian rocks of Bolivia. Until the observation of the occurrence and identification of *Pentamerus oblongus* be verified it would be well to expunge it from our list of local fossils; indeed the Rev. Mr. Woods inclines to its rejection. And as the very nature of the fossil, *Cruziana cucurbita*, precludes it from being used as a test of geological age, I conclude that the Lower Silurian age of the rocks of the Adelaide chain is not proven. Indeed, recent discoveries, which have been communicated to this Society by Mr. Tepper, necessitate their relegation to a much more ancient epoch. The chief facts are—that in the neighbourhood of Ardrossan, a lower series of metamorphic slates and limestones is covered unconformably

by fossiliferous limestones of the Lower Silurian epoch. And though the lower series underlying the fossiliferous limestones and associated strata about Ardrossan cannot be brought into direct relationship with the fundamental rocks on this side of St. Vincent's Gulf, yet their mineral character and sequence place them in accord. And the same may be said of the rocks constituting the high lands on Eyre's Peninsula.

Evidences of a missing chapter in the geological history of this province are afforded by the occurrence of rolled pebbles of stratified rocks in the oldest known of our sedimentary deposits. These are well-rounded quartzite pebbles, discovered by Mr. Scoular in the grit bands in the basal beds of the Gawler hills, and subangular pebbles of gneiss in the siliceous clay-slates at Hallett's Cove.

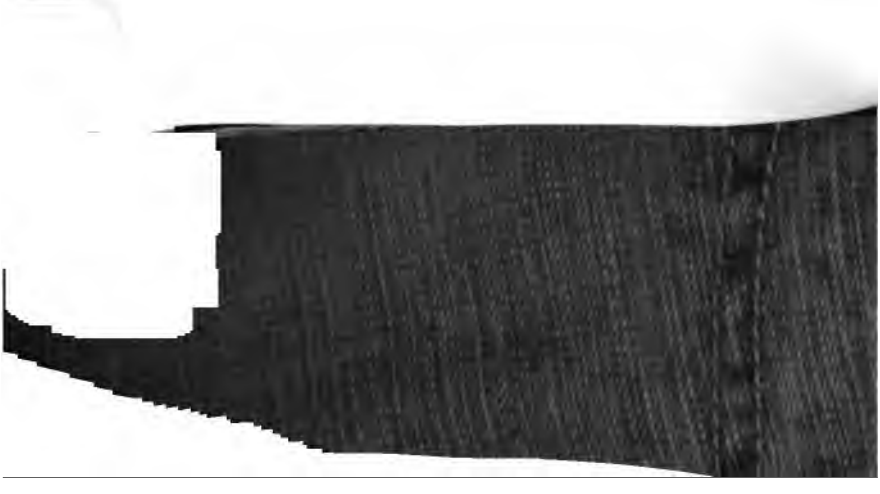
Associated Eruptive Rocks.—Though I have expressed the opinion that the great masses of granites, eurites, and syenites associated with the metamorphic strata of the Adelaide chain are probably altered sedimentary rocks, yet I do not wish it to be understood that all South Australian granites are to be included in that category. One undoubted dyke of granite is that which forms the headland of Rosetta Head, and Granite Island, and is continued to Port Elliot; its intrusive origin is obvious by the veins passing from it into the adjacent mica slate, fragments of which are also found entangled in it, and particularly by the circumstance that its course cuts directly across the line of strike of the mica slate and clay-slates. According to Mr. Burr, a similar granite is visible above water at Cape Jaffa and at Cape Morard de Galles.

Granite dykes of small dimensions, but numerous, traverse the sandstones and metamorphic rocks as you approach the extensive granite area at Palmer from the west; but the two rocks are mineralogically very different.

Intrusive rocks are, however, infrequent in the Adelaide chain; Mr. Selwyn noticed felspathic granite at Mount Bryant. In the Flinders Range he observed a small greenstone dyke on the east flank of Mount Remarkable, and Mr. Ulrich has described dioritic dykes at three other places in the Flinders Range to the north of Port Augusta.

Lower Silurian Rocks.

Mr. Selwyn describes the whole of the country from Mount Remarkable and Port Augusta, north-east of Mount Serle, as occupied by sandstones, purple and grey shales, and siliceo-calcareous beds resting unconformably on the more slaty series which covers the surface to the southward. This unconformity is illustrated by a sketch section of Mount Remarkable, the description of which runs as follows:—"At Mount Remarkable



a soft aluminous stone of reddish white, pink, and brown tints is used for building. Immediately to the west of the village these beds are dipping 85 degrees to the westward, and are overlaid by soft red gritty quartzose sandstones; and towards the summit of the Mount thick bedded quartzose sandstones and siliceous freestones dipping at about 15 or 25 degrees to the westward."

These beds occur in great anticlinal and synclinal undulations, such as is seen in the singular and picturesque Pound Ranges at Wilpena and Warraweena. Their sequence, as determined by Mr. Selwyn, is as follows, in descending order:—

1. The upper quartzose sandstone and quartz rock series, which, commencing with the summit of Mount Remarkable, extends through all the peculiar flat-topped and tent-shaped hills west of Port Augusta, and forms generally the summits of all the higher peaks and ranges as far north as Mount Serle.

2. The hard fine-grained and micaceous green, grey, and purple slate, sandstone, and flag series underlying the above, as seen in the Flinders Range at Horrock's Pass, and in Elder's and Chase's Range, and on the west side of Spencer's Gulf.

3. The siliceo-calcareous series, forming the axis of the great anticline at Arqueba, and at Angorigina, Appealina, and Oratunga.

4. The dark blue fine-grained arenaceous flags and sandstones of Appealina.

We need to place in this group of strata the coarse siliceous sandstones that form the higher portions of the Mount Lofty Ranges, which Mr. Selwyn considered as part of an upper unconformable formation. From a cursory examination I was led to form the same opinion, and estimated the thickness of the unconformable beds on Mount Lofty at 700 feet. The extent of the coarse sandstones is fairly well defined by the forest of the Stringybark Eucalyptus.

No trace of organic remains had been found by Mr. Selwyn, "unless, indeed," he writes, "the peculiar circular and oval shaped markings in the quartzose sandstones west of Port Augusta are annelide tracks."

Strong presumptive evidence of the fossiliferous nature of some of the rocks which occupy the surface of the Northern Areas is afforded by the following observation:—I have in my possession an ovoid stone, such as is used by the aborigines for pounding *nardoo* seeds. It was picked up by Mr. Gipps (then on the Ordnance Survey) in the Lake Torrens district, who noticing traces of fossils on the exterior broke it across, and thereby happily displayed several well preserved specimens of

Orthis calligramma, a characteristic Lower Silurian fossil. The matrix is a calciferous sandstone of a grey colour.

Though Mr. Selwyn has not assigned the upper unconformable series to any geological epoch, yet he leads us to infer the probability of its belonging to the Devonian period. Another geologist, Mr. Ulrich, who has had opportunities for forming an opinion upon the successional order in the rocks to the north from Port Augusta, does not fully confirm the observations of Mr. Selwyn. He says, "I agree with him, for the same reasons he advanced, in unhesitatingly assigning them to one of the older epochs of the Palæozoic period—the Lower Silurian being perhaps the most likely one. Owing, probably, to my rapid mode of travelling, I was not able, however, to recognise the features upon which Mr. Selwyn based their subdivision into older and newer; for, throughout the country traversed, from the Burra northward, I saw no evidence of any unconformity in the strata; they seemed to me to represent one and the same grand series, only in places more or less metamorphosed by contact with intrusive rocks." (Mineral Resources north of Port Augusta, Parl. Rep., p. 18).

The discoveries made by Mr. Tepper, and referred to on p. xlv. confirm Mr. Selwyn's opinion that our Palæozoic rocks belong to widely separate periods; but they, at the same time, necessitate an alteration in the terms by which they have been designated. The fossils, which have been obtained from the thick "Parara" limestone, overlying mica slate, marbles, &c. (see Tepper's paper, Phil. Soc., Adelaide, p. 71), consist chiefly of heads and other fragments of a species of blind trilobite, probably an *Olenus;* but other forms observed are several examples of a small species of *Ecculiomphalus*, a *Capulus*, slender conical casts of an *Orthoceras* or *Creseis*, and fragments of corals (some of which showing a cystiphylloid structure). That we have herein a Silurian facies is not likely to be questioned; but to what group of the Lower Palœozoic rocks should the limestones yielding the fossils be referred, is a question that had better be reserved till more tangible evidence is forthcoming. That we are on the eve of a great discovery, so far as concerns the classification of South Australian Primary rocks, must be conceded.

MESOZOIC.

Jurassic.—The Rev. W. B. Clarke, in his "Sedimentary Formations of New South Wales," p. 84, does not credit South Australia with the possession of Mesozoic rocks, fossiliferous evidence of which had been publicly made known previous to the publication of that work. He had evidently overlooked the very brief announcement made by me, Quart. Journ. Geol. Soc., p. 258, 1877, that *Belemnites* allied to *B. australis*,

Phillips, and other Jurassic fossils occurred at Stuart's Creek; and had lost sight of the fact that Mr. C. Moore, Quart. Journ. Geol. Soc., 1870, records the existence of a Jurassic fossil of Queensland, *Cytherea Clarkei*, Moore, on the Gregory, north of Finniss Springs.

The history of the discovery of Mesozoic fossils at opposite extremities of the continent will be found in the papers by Mr. Moore, *op. cit.*, and Mr. Daintree, same journal, 1872. The Jurassic fossils from Queensland are referred to 89 species, not one of which is, with certainty, identical with European forms, whilst those from West Australia, which belong to 80 determined species, are for the most part of European origin. It is also noteworthy that there are no species in common to the two Australian areas. The distinctness of the faunas renders it highly probable that widely separated periods are represented by them, and I am strongly of opinion that the Queensland type approximates to a Cretaceous facies. However, there are no decided points of contact between the marine faunas of the Jurassic and Cretaceous periods of Queensland.

The South Australian localities affording Jurassic fossils are in the interior and on the line of the transcontinental telegraph; the more distant locality is the Peake, 700 miles from Adelaide; the nearer one is Stuart's Creek, where Stuart found the species of *Cytherea*, first mentioned by Clarke, and subsequently named by Moore *C. Clarkei*. Mr. F. G. Waterhouse, in his report "On the Features and Productions of Country on Stuart's Track across Australia," records the discovery in the following terms:—"I was fortunate to find in the vicinity of the Gregory and the Welcome Springs, in small portions of argillaceous rock, which here and there crop out on the surface of the plain, some fossil wood and shells. The shells are marine, and consist of mussels and three other species of bivalves. I am not able at present to ascertain whether these fossil shells are identical with the recent ones found on our coasts, but I am inclined to think they are not. I hope at some future time to be able to decide this, as it would throw much light on the geological formation of this part of the country by showing to which of the divisions of the Tertiary formation this argillaceous rock belonged" (p. 2.) Seventeen years have elapsed since the above observations were made, and so far as I can ascertain the inquiry has not advanced one iota. An examination of the specimens has proved that they belong to species forming part of the small Jurassic fauna made known to me through the collections forwarded by Mr. Canham, of Stuart's Creek, The following notices of fossiliferous rocks, made by Mr. Waterhouse, doubtlessly refer to the same formation:—"Near the base of Mount Beresford I found in some detached portions of

an argillaceous rock some fossil marine mussel shells." And again, they "were kind enough to collect for me some valuable fossils from the vicinity of Mount Margaret." From the vicinity of the Peake I have received from Mr. Canham Belemnites and other Jurassic species identical with those at Stuart's Creek.

Of the fossils which admit of specific determination, five occur in Queensland, whilst one only is referable to a Western Australian species.

List of Jurassic Fossils from Central Australia.

Belemnites australis, Phillips.
Belemnites Canhami, Tate *(m.s.)*
Natica variabilis, Moore.
Monotis Barklyi, Moore.
Modiola unica, Moore.
Modiola sp.
Cytherea Clarkei, Moore.
Cytherea, or Chione spp., in casts.
Rhynchonella variabilis, Moore.

CRETACEOUS.—The Cretaceous rocks occupy in Queensland, at a rough approximation, 200,000 square miles, for the most part good pastoral land. They present the physical aspect of vast plains stretching westward from the main dividing range to about the meridian of Central Mount Stuart. That this portion of the Mesozoic system extends throughout the whole of Central Australia is more than probable, hidden, however, over large areas by the "Desert Sandstone."

Though we have no internal evidence of the existence of Cretaceous strata in this province, yet as those of Central Queensland have been traced up to our boundary by Mr. Daintree, it can only be a question of time that is involved in substituting the presumptive by the positive.

Mineral Springs.—There is one subject of practical interest connected with the distribution of the Jurassic rocks, and that is the occurrence of hot mineral springs, which suggest the probability of obtaining supplies of water on the Artesian principle over some portions at least of the Mesozoic plains, and possibly over those portions covered by the "Desert Sandstone."

These springs are situated around the southern and western shores of Lake Eyre, and as they flow to the surface of an open level plain in an arid climate they are doubtlessly natural artesian wells. Some writers have attributed to them a volcanic origin, from the circumstance that from their overflow a crater-like mound of sinter has been deposited.

One of the Primrose springs on the Neales River has a tem-

perature of 108 degrees, and others of them are hot an
The description of Blanche Cup Springs by Mr. F. G.
house will serve as a type:—"This is the most be
volcanic cone I have seen. It rises about the height o
thirty to forty feet, and the cup or crater at the top i
forty feet in diameter, and is filled with fine limpid wa
circled with fine tall green reeds. This *lava* is of a ver
and compact nature, of a grey colour, and much re
siliceous limestone."

Older Tertiary.

The older Tertiary deposits of undoubtedly marine
occupy three basins, which are not now coterminous.
are:—

1. The Murray basin. 2. That of Aldinga and S
Yorke's Peninsula; and 3. That of Bunda, Gre
tralian Bight.

The Murray basin is the most extensive, and embrace
the whole of the country in South Australia to the e
south of the River Murray, and, moreover, a considera
resting on the west and north bank of that portion of t
within our territory.

The strata, which constitute the vast plain of the Sou
extend across the Victorian frontier, and occupy the
the Lower Glenelg River, thence the coast line by I
Warrnambool, and Cape Otway to Geelong. This pc
South Australian geology has had not a few histor
earliest of whom was Sturt, who, in tracing down the
from the Murrumbidgee in 1829, found that the river
130 deg. long. (somewhat eastward of the boundar
province) entered a gorge, the limestone walls of wh
highly charged with marine fossils. The descriptio
River Murray Cliffs given by Sturt (see Expeditions
Australia, vol. II., p. 139, 1843) is to this day the only
source of information respecting the most interestir
geological features of this colony. Nevertheless, the
fossils of the River Murray have a long story to tell, f
Sturt's observations are accurate, yet he did not view
eye of the experienced geologist.

Passing to that portion of the Murray Basin whic
around Mount Gambier, we have in the several wor
Rev. J. E. Woods, F.G.S.—particularly in his "
Observations in South Australia," 1861—an exhausti
on the stratigraphical phenomena, not only of the Olde
beds, but of the newer deposits, of this the most
portion of this province.

The Aldinga and Yorke's Peninsula Basin. I ha
referred to the occurrence of Older Tertiary strata in t

nected areas on the east side of St. Vincent's Gulf, viz., the Myponga Flat, and the Willunga Plain. Other patches of smaller size are the ridge which extends from Adelaide to the Stockade, and at Gawler, and at further points still further north towards the head of the Gulf. These are remnants of a vast sheet which must have occupied the greater part of what is now St. Vincent's Gulf, as similar beds form the north-west coast line of Kangaroo Island, and the whole of Southern Yorke's Peninsula, extending as a littoral fringe as far north as Ardrossan. On the shores of Spencer's Gulf these strata continue northward beyond Wallaroo, and probably continue around the head of the Gulf.

Mr. Tepper has occupied himself with the stratigraphical phenomena of these rocks about Ardrossan, and has endeavoured to bring them in accordance with those at Aldinga, briefly sketched by me in last year's "Transactions."

The Bunda Basin, details concerning which have been communicated to you in my paper "On the Natural History of the Bunda Plateau," published herewith.

It is probable that the marine beds do not in either the Murray or the Aldinga Basins rise to more than 200 feet above sea level, and that the general upper level does not exceed 150 feet; but their elevation is certainly as much as 250 feet in the seaward edge of the Bunda Plateau, and must be at least 100 feet more in its interior.

Correlation and Age.—The Rev. Mr. Woods has grouped what I have called the Older Tertiary rocks of the South-East Plain into three divisions, based upon physical, lithological, and palæontological differences. Independent observations on the rocks of the Murray Cliffs and of the Aldinga and Bunda Basins have led me to the adoption of a like classification; though I am not sure that the arrangement is identical in each case, and it is certain that we are not in accord as to the correlation of the various members in the eastern and western parts of the Murray Basin, and their relation to the Victorian beds.

In the following table I have arranged the divisions recognised by me, in reference to typical sections in each of three basins:—

<table>
<tr><th>R. Murray Cliffs.</th><th>South-East.</th><th colspan="2">Aldinga.</th><th>Yorke's Peninsula.</th><th>Bunda Cliffs.</th></tr>
<tr><td>Upper Murravian. Shell limestones oyster beds, and sands.</td><td></td><td colspan="2">Upper Aldinga series. Calciferous sandstone, impure limestones, oyster banks.</td><td>Crystalline limestones at Tickera. Turritella grits at Ardrossan.</td><td>Marbles.</td></tr>
<tr><td>Middle Murravian. Calciferous sandstone with polyzoa.</td><td>Yellow polyzoal limestone of Narracoorte.</td><td rowspan="3">Polyzoal sand-rock, marls, sands and earthy limestones.</td><td rowspan="3">Lower Aldinga Series.</td><td rowspan="3">Muloowortie clays.</td><td>Polyzoal limestone.</td></tr>
<tr><td>Lower Murravian. Ferruginous sandstone and polyzoal limestones.</td><td>White polyzoal limestone of Mount Gambier.</td><td rowspan="2">Chalk rock.</td></tr>
<tr><td></td><td>Chalk rock of MacDonnell Bay.</td><td>Glauconitic limestone.</td></tr>
</table>

The fossiliferous formations of the River Murray cliffs have, from their first discovery, been referred to the Tertiary epoch; and those of the South-East have been regarded by their describer as with them forming part of only one deposit. The Victorian geologists recognise different groups of strata in their Tertiaries; and have applied to them classificatory terms such as are used by European geologists to designate the primary divisions of the Tertiary epoch. Prof. Duncan strongly condemns this practise, and advises us to speak of the Australian Tertiaries, as older, middle, or newer; and he has set the example by calling the strata under review as Middle Tertiary. But the very same grounds which justifies the application of "Middle" will justify the employment of "Miocene" or other term, which simply expresses the age of the fauna relatively to that of our own shores. The principle of classification introduced by Sir C. Lyell is equally applicable

to the Australian as to the European Tertiaries, as merely expressing the absolute proportion of locally recent to extinct species in a given deposit. And it seems to me that so far as the Australian deposits are concerned, no other meaning is intended to be conveyed by the terms made use of.

That the Australian fossil fauna shows an increasing specific relationship to the recent fauna, as we rise in the series of Tertiary deposits, cannot be denied. In other words, our continent has had its successive periods to which the terms Eocene, Miocene, and Pliocene may usefully be given, without implying that these were synchronous with those of the European.

To what period or periods of the Tertiary era should be assigned the South Australian deposits? I will not answer the question direct, or without reference to the classification employed by the geologists of Victoria. Of the several localities, yielding Older Tertiary fossils, none perhaps has had its organic remains so fully illustrated as Muddy Creek, near Hamilton; and apart from the published data for comparison, I have collected a very large suite of fossils from the beds at that place. If contemporaneity be proved by identity of organic contents, then the Muddy Creek beds are the direct equivalents of the Upper Murravian series, as is shown by the following summary of the results of a careful comparison between the fossils from each. Nearly all the Muddy Creek species described by McCoy and Woods are in my collection, but the few desiderated forms are included in my enumerations :—

Classes represented.	No. species in Upper Murravian.	No. species in Muddy Creek Beds.	No. species common.
Cephalopoda	3	1	1
Gasteropoda	89	210	64
Conchifera	34	43	24
Palliobranchiata	3	7	2
Echinodermata	2	3	2
Corals	7	24	6
Total.	138	288	99

The classes of Mammalia, Pisces, Crustacea, and Annelida show each a few species in common, but the total numbers in each in class are very small. Polyzoa are, however, represented by numerous species at both localities, but their examination has not yet been attempted, though a cursory glance impresses you with the belief of the complete identity of the two collections. The large percentage of seventy-two

of Upper Murravian fossils present in the Muddy Creek beds justifies the assertion made last year (Phil. Soc., p. 121) that the upper marine strata exposed in the River Murray cliffs are the direct equivalents to the Muddy Creek beds, the next step in the brought the youngest member of our Older Tertiary into co-relation with the Muddy Creek beds, the much larger inquiry is to ascertain the age of the latter, the indirect number of fossils contained in which makes this indirect method the more satisfactory. The Victorian geologists do not seem agreed on this point. McCoy oscillates between Upper Oligocene and Older Pliocene, whilst Selwyn regarded the Muddy Creek beds as the oldest of the Tertiaries in Victoria, an opinion with which I do not concur. The proximity of the Older Tertiaries of Tasmania, which occur on the north coast at Table Cape, to the Older Tertiary deposits of Victoria, suggests the propriety of correlating them with those of the mainland; and so far as the examination of a limited number of their fossils goes, I consider them to be the equivalents of the Muddy Creek beds, and, therefore, probably of those at Geelong. Not having critically compared all the Muddy Creek fossils with living forms I am not prepared to express more than a tentative opinion on the proportion of living to extinct species; but of the 288 species, eighteen are certainly recent, or a little more than 6·2 per cent. I therefore think that we may safely refer the Muddy Creek beds to the Miocene period. Even by taking collectively the fossils in contemporaneous beds, the proportion of living to extinct species is not more than six per cent. The living species fossilised in these beds are as follows:—

The identification of those species marked by an asterisk (*) is on the authority of the Rev. J. E. T. Woods, and those marked thus † on the authority of Prof. McCoy. † Indicates that the author has examined the species.

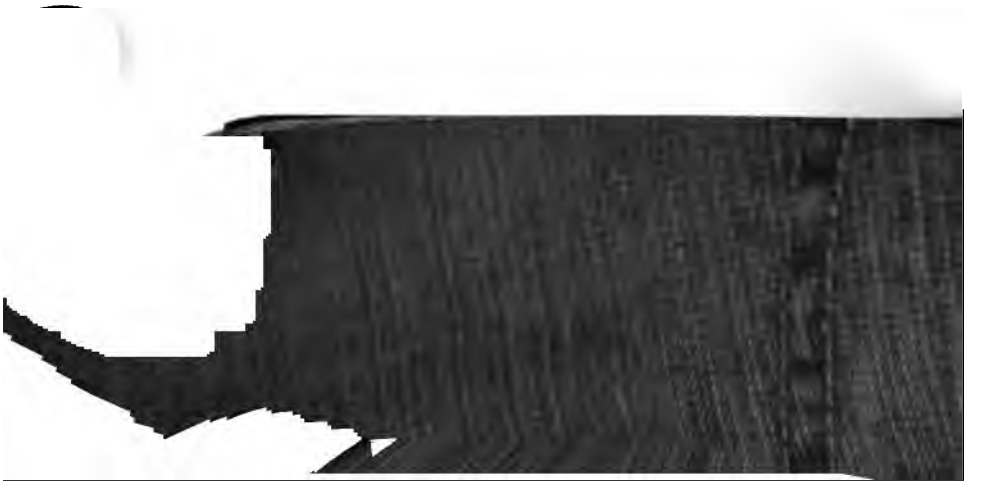
		Upper Murray.	Aldinga.	Muddy Creek.	Table Cape.	Recent.
1.	Ancillaria Australis, Quoy	*†	..	*†	*	N. Zealand.
2.	*Syrnola bifasciata, Woods	..	..	..	..	Tasmania.
3.	Cochlolepas foliaceus, Quoy	..	..	..	..	S. Australia.
4.	*Liotia discoidea, Rv. ?	..	*†	*†	*	Tasmania.
5.	Fissurellidea concatenta, Crosse	..	..	*†	*	
6.	Fissurella nigrita, Sow.	*†	..	*†	..	S. Australia.
7.	Tugalia parmophoridea, Quoy	..	..	..	..	S. Australia.
8.	Emarginula striatula	*†	..	..	..	
9.	Emarginula dilecta, Angas ?	*†	..	..	..	S. Australia.
10.	Cylichna australis, Quoy	..	..	*†	..	N. Zealand.
11.	Cadulus acuminatus, Deshayes	..	..	*†	..	S. Australia.
12.	*Dentalium lacteum, Deshayes ?	..	..	..	..	Tasmania.
13.	Ostrea (cf) edulis, Lin.	*†	..	*†	*	S. Australia.
14.	Pecten bifrons, Lk.	..	..	..	..	India.
15.	Pecten asperrimus, Lk.	*†	..	..	..	Temp. Seas.
		..	..	..	..	S. Australia.
		..	..	..	..	S. Australia.

16. *Leda inconspicua, Bv.	..	..	*	..	———
17. Limopsis Belcheri, Adams	*†	*†	*†	..	S. Australia.
18. ‡Limopsis aurita, Sassi	..	..	*†	..	Europe.
19. Pectunculus laticostatus, Quoy	*†	..	*†	*	N. Zealand.
20. ‡Trigonia acuticostata, McCoy	*†	*†	*†	..	E. Australia.
21. ‡Corbula sulcata	*†	..	*†	*†	W. Africa.
22. Terebratella Cumingiana, Davidson	..	..	*†	*	N. S. Wales.
23. *Sphenotrochus variolaris, Woods	..	..	*	..	N. S. Wales.
24. Flabellum candeamum, Ed. and H.	..	..	*†	..	China.

Other fossils have been referred to living species—to *Trivia Europæa*, *Leiostraca subulata*, *Lima subauriculata*, *Liotia lamellosa*, Woods, &c., but competent authorities have not confirmed these identifications. On the other hand, the Geelong coral, *Deltocyathus italicus*, Ed. & H., better known from the Italian Miocenes, is considered by Count Pourtales and Sir Wyville Thomson to be specifically distinct from its living analogue inhabiting the deep waters off the coast of Florida—an opposite opinion to that held by Professor Duncan. *Flabellum distinctum*, Ed. & H., a living coral in the Chinese seas, is fossil in the Victorian and South Australian Tertiaries older than the Muddy Creek beds.

If, then, we relegate the youngest member of our older Tertiaries to the Miocene period, where are we to place the older ones, particularly the inferior beds of the Aldinga series? The Lower Aldinga series contains not only a large number of restricted species, but a small modicum of recent forms. Thus of 116 known forms 34 pass up into the Upper Murravian and its contemporaneous deposits; whilst the number of recent species is not more than four. A summary of the determinations upon which the above figures are based is set forth in the following table:—

Classes.	No. Species in L. Aldinga Series.	No. Species common to L. Aldinga Series and the Upper Murravian and Muddy Creek Beds.
Cephalopoda.....	3	2
Gasteropoda.....	40	15
Conchifera	28	9
Palliobranchiata	18	6
Echinodermata	21	1
Corals	11	1
Total	116	34



The living species present in these beds are:—

Terebratella Cumingiana, Davidson. Very rare in the middle beds of the Aldinga section, but plentiful in the Lower Murravian, and in the Mount Gambier beds.

Flabellum distinctum, Ed. & H. Common.

Limopsis aurita, Sassi. The Aldinga fossils are identical with the New Zealand and Chilian Eocene form, *L. insoluta*, Sow., which may be synonymic with the above.

Emarginula dilecta, Angas. An *Emarginula* from Aldinga is doubtfully referable to *E. transenna*, Woods, of the Table Cape Miocene, which may possibly prove to be the recent South Australian *E. dilecta*.

Accepting the above determinations, the proportion of living to extinct forms in the Lower Aldinga series is, expressed by percentage number, 8·5. And if the species of the Middle and Lower Murravian and of their equivalents in the South-East be similarly compared, I am confident that the percentage of living species will not be materially increased, though a larger percentage of forms will be found to pass from the middle to the upper series. But if we confine our examination to the fossils of the glauconitic limestones at Aldinga and of the contemporaneous chalk rock of the Bunda cliffs, we not only find a larger number of peculiar genera and others alien to the recent Australian fauna, but encounter some points of contact with the Eocene fauna of New Zealand. Regarding the last particular I can speak with confidence as to the identity of six of our fossils with those from the Upper Eocene or Ototara group of New Zealand, but in the absence of actual specimens for comparison I hesitate to refer several others to species from the same deposit.

The obviously higher antiquity of the fauna of the glauconitic limestones at Aldinga necessitates the separation of our Older Tertiaries into two distinct groups—the one referable to the Eocene, the other to the Miocene; and it may be well, for the present, to regard the Upper Murravian series as Upper Miocene, and the middle and lower portions as Lower Miocene, restricting the Eocene as indicated above.

Upland Miocene and Desert Sandstone.

There succeed in conformable position to the uppermost marine beds at Aldinga, at Adelaide, and along the banks of the Lower Murray River, unfossiliferous clays, which from the fact of their gradual passage into beds presenting unmistakable evidence of fluviatile origin, may be regarded as estuarine.

The shore line of the Miocene sea is distinctly traceable at a few points in the Aldinga Basin. Passing inland from the mouth of the Onkaparinga, the marine beds, which form the

bold headland of Wilson's Bluff, gradually change their character, and at Noarlunga give place to sands and shingle.

Again, the scarped ridge east of the main street of Gawler is made up of coarse sands crowned by rounded gravel; the sands contain blocks of stone, resulting from consolidation of the sands by carbonate of lime, which yield a few marine fossils, and also silicified stems, having a structure resembling that of *Casuarinæ* and *Eucalyptus*. The process of silicification took place subsequent to entombment in the marine or estuarine beds, because the stems are not unfrequently found to be drilled by Teredos. As we proceed towards the ranges, the depressions in the Palæozoic rocks are levelled up by more or less angular gravel, either loose or consolidated into a compact conglomerate; whilst at higher levels on the foot hills of the Adelaide chain evenly-bedded sandrock, mottled clayey sands, and ironstone conglomerates occupy flat-topped heights, conspicuous by their scrub vegetation. If we trace the mottled clays, which cover the fossiliferous limestone at Adelaide, towards the north, we find that they are coterminous with beds identical with those just described. Indeed, strata of this character occur in patches of great or less extent from the Hope Valley Reservoir, Teatree Gully, to Golden Grove, thence to Gawler Town Hill, where they attain an elevation of 950 feet. They constitute the gold drifts of the Barossa and Humbug Scrubs, and stretch away in a narrow band by Lyndoch, Tanunda, and Nuriootpa. No other fossil remains than silicified tree-stems similar to those at Gawler have been met with in these Upland Miocenes. The amount of denudation that they have been subject to is immeasurable. They now occur as disconnected patches, separated from one another by deep ravines, and are only remnants of a long narrow incline plane bounded on the east by the Adelaide chain, but whose western confines are not extant, as in many places they form the highest ground on the Gawler Hills.

The littoral beds at Noarlunga conduct us to beds of a like nature, and doubtlessly similar origin, forming the gold-field of Echunga. In the same category must be placed the Tertiary beds of Myponga Flat, the sandstones and ironstones at Yankalilla, which there overlie marine Miocenes, the varied sandy beds constituting the scrub-lands to near Cape Jervis, among the hills to the north of Victor Harbour, along the eastern slopes of the Adelaide chain, extending northward along the valley of the Bremer to Callington.

The character of the gravels and their relation to the marine Miocenes must, in the absence of positive evidence to the contrary, be regarded as indicating a fresh-water origin. I may remark in connection with the clays overlying the Miocene

limestone that it is on their surfaces that the "Bay of Biscay" land prevails. This name is applied to tracts covered with mounds or ridges grouped in the most irregular way, and without any relation to the natural slope of the surface. The ridges, which rarely exceed a foot in height, are composed of clay, whilst the depressions are occupied by alluvium or sandy loam; and though it is generally held that the soil of the depressions extend in depth, yet my observations are totally opposed to that view. How the depressions have been formed on the clay soil, and how they have been subsequently partially filled, are questions which I hope will occupy the attention of some member of this Society.

On the Murray plain these clays are surmounted by sands, which occupy ridges surrounding plains constituted of the former; and though proof is wanting of their cotemporaneity with the Upland Miocene, yet it is not unlikely that they belong to the same epoch.

Immediately to the west of Lake Torrens the country is occupied by hard sandstones, clays, thin beds of ironstone, and gypsum; and, according to my informant, very extensive sections of these strata are exposed in the Bosworth Creek and at Andemokka. At Bottle Hill, at one mile south from Edge Hill, and between the Elizabeth Station and Coondambo, the hard sandstones there have yielded to the researches of Mr. William L. R. Gipps a plentiful supply of fossil leaves, for the most part Eucalyptoid. No other fossils were observed in these sections.

From the published description of scientific travellers, and from other sources of information, we gather that the rock formation of much of Central Australia partakes of the general character of the beds about the western shore of Lake Torrens. It is, however, hidden over considerable tracts by gravelly drift, in part derived from the subjacent sandstones. And I think that there can be little doubt that it forms a part of the "Desert Sandstone," so called by Mr. Daintree, because of the sandy, barren character of its disintegrated soil. The same author describes the formation in Queensland as unconformably overlying Cretaceous rocks and underlying lava beds, and states that all the available evidence tends to show that this "Desert Sandstone" did at one time cover nearly, if not quite, the whole of Australia. The position of the formation is presumptive evidence of its Older Tertiary age, as so far as is known the volcanic outbursts seem to belong to the Newer Tertiary period. Mr. Daintree has found in it fossil wood, but no marine fossils; though he had recorded the occurrence of a *Tellina*, but the locality he gives to it is a mistake. (See Clarke, "Sedimentary Formations," p. 95).

There is much reason for the belief that the "Desert Sandstone" is an extensive lacustrine deposit; coeval with the accumulation of the river gravels and sand of the hilly country classed by me as Upland Miocene.

Summary.—The marine Older Tertiaries, which belong to the Eocene and Miocene epochs, are confined to the existing coast-line, and extend inwards from thence in gulf and bay-like projections. They do not attain an elevation much above 250 feet. Beyond these are the vast sterile tracts of the interior of the continent occupied by the lacustrine formation termed the "Desert Sandstone," which is contemporaneous with the youngest member of the Miocene marine strata. At various places in South Australia, Victoria, and New South Wales plant-deposits occur among silicified sandstones and quartzites, often at great elevations and in several instances associated with the goldfields underlying the basalts.

Some excuse may be tendered on behalf of those, who, having no other source of information than that contained in Brough Smyth's geological map of Australia, have indulged in representing this continent during Miocene times as being for the most part submerged beneath the ocean. These Tertiary deposits were not subjected to any other alterations in their relative level than those of the most local kind. The elevation of the southern shores of the continent at the close of the Miocene period was equable, and measured by the vertical thickness of the deposits and heights at which its littoral margins now exist, it could not be more than about 150 to 200 feet within the Aldinga and Murray Basin. A depression to this amount would not submerge the interior of the continent, and would be too small to materially affect the rainfall, so that the vast rivers which now drain the Cordilleras must have then, as now, flowed in the same direction, but have discharged their waters into the great central basin—bounded on the north by the Highlands of New Guinea, on the east by the Great Dividing Range, extending on the south to the Grampians of Western Victoria. This vast inland lake or estuary was dotted with islands now forming the elevated parts of the Flinders and Adelaide Ranges, and other mountain masses in Central Australia, each with its own river basins in which were accumulated the fluviatile gravels which are scattered at various heights among our hills.

The denudation of the Desert sandstone since it became dry land has been excessive, and that of the marine deposits has been very great, as is fully attested by the existence of the wide gulf of St. Vincent's which is excavated out of them, and by the precipitous front of the Bunda cliffs and their ascertained extension below sea level for a distance of several miles.

The absence of marine Older Tertiary from the eastern flanks of the Cordilleras may probably be due to removal.

The general surface of the marine beds has, however, not been much affected by denudation, but the River Murray has cut deeply into them, leaving high yellow cliffs about one and a quarter miles apart.

Pliocene Drift or Loess.

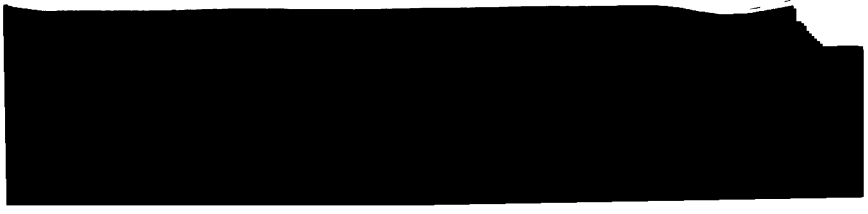
This remarkable formation forms the soil of the fertile plains on the western slopes of the Adelaide chain, and among the Northern ranges, and occupies a long strip of country of a few miles in width bordering the western margin of the Murray Basin.

It everywhere presents the same general character and qualities, and is doubtlessly the residuary disintegrated material of the slates, limestone, gneissic, and granitic rocks of the adjacent ranges. From the circumstance of its occurrence at different altitudes in various parts of the country, as also from the nature of its derivative ingredients, there can be little doubt the material of each plain or flat is of local origin. Among the derivative materials of the loess in the Valley of the Torrens at Adelaide, I have found Miocene limestones enclosing characteristic fossils, derived from the contiguous cliff; thus proving the Post-Miocene age of the formation. Nevertheless, the margin of each basin is at a uniform level.

The loess is a calcareous loam, divided into beds by irregular bands of clay or sand, which thin out at the borders, where they are replaced by angular pebbles and large blocks of stone, derived from the adjacent hills. The loess is very friable, yet consistency is imparted to it by the presence of tubular pores, branching downward like rootlets, which are lined with carbonate of lime.

The uniformity of the surface of each plain is only interrupted by the vertical walls between which all the members of a most labyrinthine valley system are sunk. Though the drift is wholly unstratified, its vertical internal structure causes it to break off in any vertical plane, but in no other; hence when a cliff is undermined the loess breaks off in immense vertical plates, leaving again a perpendicular wall. The rapidity with which even the smallest streams cut out deep channels in it is a fact that is patent to all. Channels now several yards in depth and width have been eroded in a few years along the line of a plough-furrow or of a dray-track.

Another peculiarity of the loess is that it contains the remains of only land animals and terrestrial vegetation. The land animals are restricted to some of the extinct mammalia, *Diprotodon* being particularly abundant in the loess of some of the plains of the Northern Areas. Land mollusca have been found in the loess of the Bunda Plateau.



The absence of marine organisms, and the fact of the deposit occupying tracts varying from three to ten or more hundred feet above the sea level prove in the most conclusive manner that a marine origin is impossible. I would suggest that the sea-worn pebbles found by Mr. Scoular in the loess of Munno Para have been derived from the waste of the shingle beaches of the Miocene epoch, remnants of which are still *in situ* at a few places among the Gawler hills.

The accumulation of the loess cannot arise from the silt brought by the rivers flowing from the hills into the plain without the aid of some distributing agent, inasmuch as the rivers denude the loess, and only in extreme cases when they overflow their banks do they distribute material over the plains, though it must be conceded that our streams may have lost their tendency to accumulate, and have in consequence acted as denuding agents. But, nevertheless, the accumulations from our short streams would have been concentrated about the points where they debouched upon the plain.

Indeed, I cannot resist the conclusion to which I have been led, chiefly from topographical reasons, that the loess has been deposited in a series of lakes; a subaqueous origin fulfils the required conditions, though the subaerial theory of loess formation propounded by Richthofen would equally account for the assortment of the material. Wind plays an important part in this colony as a geological agent, writes Mr. Scoular; and most of us have realised the capacity of wind as a transporter of fine material. And it is highly probable that this agent was largely concerned in the accumulation of the loess of the southern margin of the Bunda Plateau (see page 116).

One fact pointed out to me by Mr. Smeaton, confirmatory of my opinion that the drift of the Adelaide Plain was assorted in a lake, is that of the northerly trend of all the streams on their emergence from the hills, in which their general direction is to the west. My explanation of the phenomenon is as follows:—In consequence of the prevalence of south-westerly winds then as now, the direction of the current of the stream would be deflected towards the north as its volocity was slackened on coming in contact with the lake water, but before commingling with it. Thus would be formed a subaqueous channel which would be projected lakewards as the waters slowly decreased, and along which the lengthening streams would naturally flow.

My theory of the formation of the drift requires climatical conditions somewhat different from those which now obtain; it demands the operation of aqueous agents more active than now. It implies a period of greater precipitation. If the loess be the insoluble products of the weathering of rocks, has the material

been removed by the action of the rain, or as the ground moraine of glaciers? Was there ever a time when large masses of ice descended down the gullies and discharged the ice-borne materials into a lake? We know that such an agency is at work in New Zealand, and in past times its glaciers descended far lower than their present termini.

I cannot connect the accumulation of the loess with the glacial phenomena about to be described, and though the glacial theory of its origin may account for the facts, yet it does not follow that the theory is true.

One familiar with the appearance of a glaciated country cannot have failed to recognise a certain resemblance that our hills bear thereto. Mr. Woods writes:—"Indeed, it seemed to me that there were very distinct marks of snow, and the action of glaciers. This would declare the range to have been once of extraordinary elevation, probably the axis of some former continent" (Geol. Obs., p. 20). I shall be asked at once whether glacial inscriptions have been found—the grooves, striæ, and polished surfaces so characteristic of the rocky surfaces over which glaciers have travelled. I answer that such traces of moving ice do occur. They are—(1) Smooth, striated, and grooved rock surface in the bed of the Inman, Cape Jervis Peninsula, as recorded by Mr. Selwyn in the following terms:—"The direction of the grooves and scratches is east and west in parallel lines, and though they follow the course of the stream I do not think that they could have been produced by the action of water, forcing pebbles and boulders detached from the drift along the bed of the stream. This is the first and only instance of the kind I have met with in Australia, and it at once attracted my attention; strongly reminding me of the similar markings I had so frequently observed in the mountain valleys of North Wales."

I may quote *en passant* the words of Mr. Howitt (Quart. Journ. Geol. Soc., vol. xxxv., p. 35, 1879) referring to glacial signs in the mountain-tracts of Gippsland, Victoria:—"I have nowhere met with grooved or scratched rocks, &c., or any traces of ice-action; and I think that had such existed they would have been met with ere this. Mr. Selwyn has, I believe, already noted this. The only features of the country which I think could in any way suggest glacial conditions are the apparently ancient lake-basins near Omeo."

In all the discussions which I have read on the question—Did Australia participate in a glacial period analogous to that of the Northern Hemisphere?—I find no reference made to Mr. Selwyn's observation, quoted above; probably because unknown, possibly because of its uniqueness. Recent discoveries confirm, however, the correctness of that gentleman's interpretation of the signs.

(2.) Smooth, grooved, and striated rock surface, and moraine *debris* at Black Point forming the southern boundary of Holdfast Bay.

That headland presents a steep cliff face of about 50 feet high to the sea, and there stands back a few yards from its edge a low mural escarpment of Miocene. The intervening space, which is nearly flat, is covered by drift material, chief amongst which are angular stones and blocks of red granite, gneiss, hornblendic slate, and quartzite; the nearest depot for which is at Normanville, 35 miles to the south. Over some few square yards, the drift has been removed, disclosing a smooth surface of siliceous slate, striated and grooved in a north and south direction.

(3.) Passing to the south, across the mouth of Field's River, moraine *debris* and larger masses of transported rocks are seen encumbering the flat tops of the sea-cliffs.

(4.) Other signs, which taken alone would have little value, but read in the light afforded by the indubitable signs of glaciers in the valley of the Inman and at Black Point, come to have significance; these are the *roches moutonnées* surfaces of the mica slate on the south flank of Kaiserstuhl, and similarly large rounded surfaces at Crafer's, both localities in the Adelaide chain.

The late Sir R. Hanson had in his possession, so I have been informed, an ice-worn pebble, obtained from the Torrens drift. Mr. J. D. Woods, in letter May 14, 1877, supplies the following particulars:—"I think that if you investigate the Torrens Gorge, you will find evidences quite as strong as those quoted by Mr. Selwyn. On one side of a hill there is a stream of *debris* which my brother (Rev. J. E. T. Woods) considered to have been left by a moraine. In the bed of the river, near the cottage on the right side, there is a lump of rock, which some twenty years ago used to be called the "elephant rock" from its outline. The front part of it has been broken away, so now it retains nothing of the special characteristics which gave it its name. The sides are indented with striæ and there seems to be no doubt that it must have been carried by some force from a long distance."

Such are the signs of the former existence of ice-action in South Australia. If the ice originated within the country, then it must have been the result of either

1. The prevalence of a very much colder climate, or
2. That the land stood at much greater altitude (say 10,000 feet), or the mountains may have had a more plateau-like form, and therefore need not have been so high, and consequently collected more snow, or
3. A combination of both.

If, however, the scratches and moraine *debris* be attributed to the grounding of icebergs shed from the highlands of the Southern Ocean, as conjectured by Mr. Scoular, then a considerable amount of depression must have taken place, and to account in this way for the deposition of the drift and for the presence of the obsidian bombs scattered here and there throughout the whole of the southern parts of this province, the depression must have been great enough to submerge all of the province below 1,000 feet or so in elevation. I need hardly add that the known facts do not warrant such assumption.

On the limestone surfaces of the Murray Basin and the Bunda Plateau the loess is absent over very large areas, and when present is of very shallow depths. In these areas it could only originate from the insoluble residue of its limestone rocks, which from their purity could only yield an appreciable quantity by secular decay continued through prolonged periods. In the oasis of the Bunda Plateau the subaerial origin of the loess is incontestably shown, and it is highly charged with land shells, vegetable *debris*, from top to bottom.

The loess in the South-east Plain is mainly preserved in the pockets and depressions of the Miocene limestone, and in the neighbourhood of the volcanic cones is covered up by ash beds. It contains the remains of the large extinct Mammalia, and the period of its formation must be coeval with that forming the fertile plains of Adelaide, &c. At this time the caves in the South-east must have been frequented by the extinct mammals whose remains are embedded in their stalagmitic floors.

Retrospective Glance.—During the Pliocene period the land was much elevated, probably into regions of perpetual snow. The continent was then obviously vastly more extensive than now. Tasmania and New Guinea would then be united to the continent, as is required by the community of species of certain plants and animals. It was during this time that the large mammals roamed over the land, and the wide expanse of country allowed of the development of its peculiar and extensive fauna. The climate moister, and the temperature of lowlands more equable than now, and generally the conditions were favourable to the growth of succulent herbage capable of sustaining a large and varied mammalian fauna. The seas that laved the shores had their inhabitants, but of them we have no record, because the sites of their habitats are now far beneath the waters. This period was brought to a close by the lowering of the land—gradually, it may have been—and in consequence of which its glaciers retreated and finally disappeared, and the fertile tracts of the lowlands were submerged, and the produc-

tive powers of other areas diminished by the gradual dessication going on. In this way the animals would be crowded on limited areas, and a struggle for existence would ensue, in which the less adapted and less easily modifiable would succumb. Of these the larger animals would probably be the first victims, because of their slow breeding powers and of insufficiency of food within easy reach. The clumsy Diprotodon would soon be worsted in the struggle, while the fleeter Kangaroos could continue to hold their own for a longer period; and the extinction of the Thylacoleos would be involved in that of its prey.

Comparing the climatic conditions of the Pleocine Period—distant, but geologically recent, with those of the Present Period—we cannot doubt that a great change has come over the surface of South Australia in the decreased amount of water in the lakes or running in the rivers, in the increase of its mean annual temperature, and in the depauperization of its mammalian and avian fauna. Historical evidence affords no data, and exact observations with the raingauge cannot possibly have extended over a sufficient length of time to enable us to decide whether this change has been continued to our time. What little evidence can be adduced from geological observations is to the effect that the tide of dessication has turned, rather than to its continuance. The evidence to which I allude is that of the recent elevation of land, by which process our hill-tops are lifted into higher and colder strata of the atmosphere, and aqueous precipitation is increased. That these changes have occupied a vast interval of time is proved by the amount of denudation our "Drift" has undergone, as exemplified by the truncation of the Adelaide and Willunga Plains. In the case of the latter the Drift forms seacliffs rising to an elevation of 350 feet, whilst its western boundary has been totally removed.

Pleistocene.

The Rev. J. E. Woods describes the coast at Guichen Bay as consisting of rough craggy rocks of coarse-grained sandstone, "which, though not rising very high, are bold and abrupt, sometimes presenting a perpendicular face to the heavy surf which beats upon that coast." He recognises the false bedding, notes the absence of fossils, and concludes "that the deposit was from ocean current, but also that it was a considerable distance from any land." He further remarks that it is found more or less all round the coast of the colony of South Australia, and perhaps it extends all along parts of the Australian Bight. Personal examination of much of the whole coastline between Cape Northumberland and Eucla confirms the statement of Mr. Woods. In my paper on the country around the Head of the Bight I have described this formation somewhat in

detail; and the phenomena observed there are common to all sections on whatever part of the coast, namely, coarse sands and sandstones, distinctly false-bedded, and though consisting of minute shelly particles and particles of quartzose and calcareous sand do not contain marine shells, but are often highly charged with the local land shells. These appearances clearly indicate that the deposit was formed from blown sand. From the circumstance that it forms precipitous cliffs and is continued far out to sea, forming those submerged reefs which render the coast from Cape Northumberland to Guichen Bay so very perilous to navigators, I conclude that it is separably from the loose sand dunes, which elsewhere fringe the coast, and not unfrequently overlie it, by an interval of time marked by slight oscillations of level. In other words, that during the period of its accumulation the land stood relatively higher than it does now. This was succeeded by a depression amounting perhaps to not less than 20 feet to allow of the sea to overflow those extensive low-lying areas occupied by deposits containing existing marine species, which occur all along our shore margin.

Upheaval of the Land during the epoch of recent species is attested by the occurrence of raised beaches, such as at Edithburg and Victor Harbour, and by the elevated sea beds which in the South-East extend inland for several miles, and which at several points along the whole coast occupy considerable areas of what are now salt-swamps, such as those of Port Adelaide and Dry Creek, at Port Wakefield, at Fowler's Bay, &c.

The alterations of soundings on rocky ground at Rivoli Bay and at Cape Jaffa evidence that the elevatory movement is still progressing.

As to the height to which the land has been raised in recent times, many erroneous observations have been made. Mr. W. H. Light in a paper on the elevation of the Australian coast read before this Society in 1855 appeals to the fossiliferous deposit under the City of Adelaide in evidence of recent elevation. "The present vertical elevation of the highest fossiliferous stratum near North-terrace above the level of the sea, at ordinary high water is about 94 feet. Add to this the supposed limit of depth below the surface at which the beds of shells have been formed—say 50 feet—and we get a height of 144 feet as somewhere about the probable extent of elevation which this stratum has received." The Rev. J. E. Woods committed the same mistake in referring (Geol. Obs. p. 208) the Adelaide fossiliferous limestone to the Recent Period, whereas it belongs to the Miocene. And, though correct in identifying the *travertine* on Tapley's Hill at about 1,000 feet above sea level, with the limestone crust overlying the Miocene

limestone at Adelaide, yet he made a great mistake in attributing to it a marine origin, and in consequence his deduction that our hills had been raised that amount within a very recent period is based on wrong premises. Mr. Selwyn has equally misunderstood the nature of the "crust limestone." Mr. Woods, writing about the extensive area occupied by recently-raised marine beds in the South-East, has not been able to give actual heights above sea level, but ventures to estimate the amount of upheaval at not less than 80 feet. However, it is not clear, that these figures refer to the height of the shell beds or to that of the terraces of Pleistocene sandstone, similar to those of Cape Northumberland and Rivoli Bay, which divide the plain from the Coorong to Lacepede Bay at every ten miles or so.

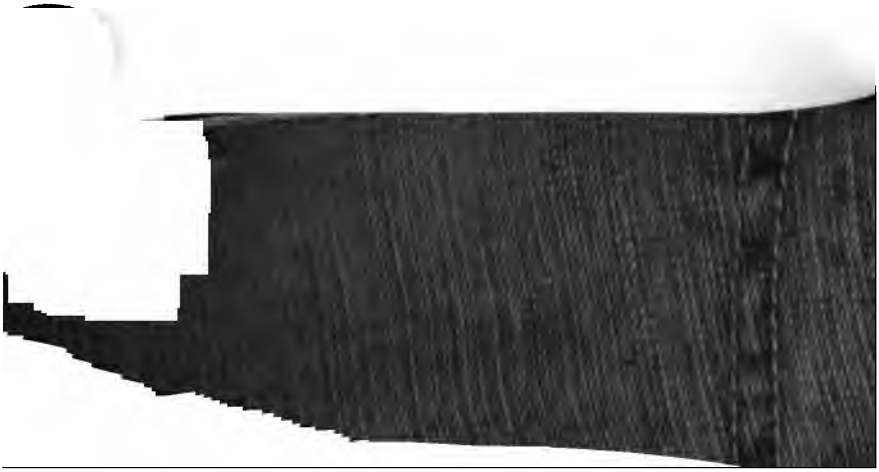
Accurate measures of the height of the marine beds composing the salt marshes resting on the Port Creek, and at Yalata, Fowler's Bay, determine that the elevation is of only slight amount.

The estuarine limestone, which fringes the Dry Creek salt marsh, and which is of about six to twelve inches thick, and crowded with *Amphibola Quoyana*, *Risella melanostoma*, and other littoral shells, is not more than twelve feet above ordinary high water mark. The limestone overlies the drift, but graduates into the estuarine muds and sands which occupy the salt marsh. The marsh is at rare intervals overflown, but extraordinary tides do not reach the estuarine limestone.

The topmost bed of the marine deposits of the Yalata swamp is only six feet above high water mark, whilst that of the Roe Plains at Eucla is about twelve feet.

Volcanoes of the South-East.—These have been very fully described by Mr. Woods, and but one question arises in connection therewith, viz., at what period were they erupted? They are newer than the Miocene, because the Mount Gambier limestone forms the base of the cones, and its fragments occur entangled in the ash beds; they are newer than the Pliocene sand and loess which are interstratified between the Mount Gambier limestone and the ash beds of the volcano of that place. The Pliocene sands and loess at this place are of terrestrial origin; they contain remains of *Diprotodon*, *Phascolomys pliocenicus*, McCoy; and leaves of *Casuarina* and *Banksia* are impressed on the under surface of the superimposed ash-layer.

Did man witness the showers of ashes and the glow of the internal fires of these cones reflected from the clouds? Probably yes! Have we any traditions? No? But palæontological evidence answers in the affirmative. Thus, the dingo (*Canis dingo*) was the contemporary of the *Diptrodon*, whose



remains are buried beneath the ashes of the Mount Gambier volcano, as proved by their remains occurring together in the Gisborne and Wellington caves.

Now, the dingo is an alien; he forms no part of the Australian fauna; and his introduction by man, as a companion and assistant in the chase, can only satisfactorily explain his presence in this continent, as in some of the Pacific islands. Man and dog may have pursued together the *Diprotodon*, and in latter times have been awed by the volcanic outbursts. Indeed, no other cause of extirpation of the huge mammals has suggested itself to the mind of Professor Owen save that of human agency. He says, "To a race of men depending, like the blackfellows, for subsistence on the chase, the largest and most conspicuous kinds of wild beasts first fall a prey."

The volcanoes of the South-East, and particularly those at Mount Gambier, are characterised by the emission of much ash and litttle lava. The volcanic energy was weak, and it was the western limit of a force having its chief foci in Western Victoria.

Though tranquil as the eruptions had been, yet there is no guarantee that the volcanoes will not again become active, and that the volume of their vomitings will be as insignificant.

Volcanic Ejectamenta beyond Present Craters.—Osidian bombs, showing no marks of erosive action, have been collected at distant parts of the colony, occurring either loose on the surface or imbedded in the "crust limestone," I have seen a specimen obtained at Gawler, from the centre of a nodule of travertine; and several that were collected about Stuart's Creek, and one from King George's Sound. I incline to the opinion that their distribution has been effected by human agency—perhaps the wish is father to the thought—inasmuch as the only feasible explanation of their presence arising from natural causes militates against my theory of the origin of the loess. Briefly, the state of the case is as follows:—

1. The bombs have not been ejected from the volcanoes of the South-east, because they are not found within their neighbourhood.
2. They may have been the outcome of some volcanoes, all traces of which have been removed by the encroachment of the sea.
3. Or they may have been brought by icebergs from the antarctic volcanoes—Erebus and Terror. By these means Mr. Scoular explains at once the ice marks on the sea cliffs of St. Vincent's Gulf and the distribution of the volcanic bombs, an opinion I do not share with him, as previously explained.

These bombs are held in high estimation by the aborigines,

a fact which proves inferentially that they are not common—that they are obtained perhaps with difficulty, and possibly by exchange. Other articles of *virtu* have been transported to different parts of the continent, and why not these? Though we may in this way account for their wide-spread distribution, yet the evidence is not conclusive till they shall have been traced to their natural sites.

I submit the following documentary evidence of the value set upon the obsidian bombs by the Australian black. A correspondent, writing from Salt River, King George's Sound, states:—"The black stones are very rare, and much prized by the natives, who believes the possessor bears almost a charmed life, and is able also to cure sick people of any complaint they may be afflicted with, as also to bewitch their enemies, or any one with whom they have a grievance, tormenting them with all kinds of diseases and finally destroying life itself." Mr. Canham, of Stuart's Creek, writes:—"With the stones will be found one to which a strange story is attached. I was told by the native I had it from that it was taken out of the breast of a sick man by one of their 'koonkies,' or doctors, who, however, did not succeed in saving the patient's life, as some other 'koonkie' of another tribe had a greater power than this one who took the stone out. The sick native, I mention, died here of disease of the lungs, and all the koonkies in the country could never have saved him."

In conclusion, I lay before you a summary of such works and papers as have come under my notice bearing upon the natural history of this province which have been published during the past year; and also some addenda to the list furnished last year.

"Transactions of the Entomological Society of New South Wales," vol. 1, 1866; vol. 2, 1873.

The Society was founded in 1862, and is now merged into the Linnean Society. The two volumes published during its existence contain, as may be expected, most useful information for the Australian entomologist. Contributors thereto, aware that the descriptions of Australian insects are dispersed through so many different books, and transactions of scientific Societies, have, in treating upon native insects, reprinted the specific descriptions of known species as given by the various authors, and have thereby relieved in some measure colonial entomologists from the disadvantages they labour under from want of access to the literature of the subject.

The example set us by the Sydney naturalists might advantageously be imitated by workers in various departments, as well as by entomologists. Conspectuses of genera, accompanied

by pictorial representations of types, when necessary, would greatly facilitate the labours of the student.

Mr. W. Macleay, in Presidential Address, vol. 1, p. 21., gives a brief summary of the earlier history of Australian entomology, down to the publication, in 1848, of Germar's paper in the "Linnæa Entomologica" on the insect fauna of South Australia, which affords fuller information than I gave in last year's address.

Lepidoptera of the Family Zygænidæ: By A. G. Butler, Journal Linnean Society, 1875, 3 pl.

Four new species of *Hydrusa* from Australia are described, and references are made to some other Australian species. The paper is a correction and emendation of Mr. Walker's list.

Description of Australian Micro-Lepidoptera: By E. Meyrick, Proc. Linnean Soc., N.S.W., vol. 3, p. 175, and vol. 4, p. 205 (1878-9). The author estimates the total number of species occurring on the Australian Continent to be fully 10,000. A certain number of descriptions of Australian micro-lepidopters are stated to be included by Walker, in his Brit. Mus. Cat., and a few by Zeller, Norman, &c. The present communication deals only with the group Crambites, of which 71 are described, 50 being new, and one genus is established. The following species were collected about Adelaide:—*Crambus trivittatus*, Z.; *C. relatalis*, Wkr.; *C. bifractellus*, Wkr.; *Etiella Behrii*, Z.; *E. chrysoporella*, Mey.; *Homœosoma vagella*, Z.; and *Aphomia latro*, Z.

Contributions towards a Knowledge of the Curculionidæ: By F. P. Pascoe, part iv., 4 plates (Journal of Linnean Society, vol. xii., 1873. Forty-one species from Australia are described, four of which are from South Australia.

Description of New Species and Genera of Eumolpidæ: By J. S. Bailey. (Journal of Linnean Soc., vol. xiv., p. 246, 1878.) Three of the new forms are from this continent; and "*Descriptions of New Genera and Species of Gallerucinæ*." (Ann. Mag. Nat. Hist., August, 1879, p. 108.)

A new species of pulmoniferous snail, living in the mangrove swamps about Port Adelaide, is technically described by Mr. Brazier, under the name of *Alexia meridionalis*, in Proc. Linnean Soc., N.S.W., vol. ii., p. 26 (1877).

Mr. E. Smith, marine shells from the Solomon Islands, Journ. Linnean Soc., 1876. Figures and describes *Nassa bicallosa* from Swan River; and *Thracia Angasiana* and *T. Jacksoniana* from Port Jackson, and reports the occurrence of *Terebra cancellata*, Quoy (*T. undatella*, Desh.) at Port Elliot.

Mr. Angas, in Proc. Zoological Soc., November, 1878, gives a list of additional species of marine mollusca to be included in the fauna of this Province. It is a supplement to a former list published in 1865, and includes a few published records of

species that have not come under his observation, whilst the bulk of the additions is based upon material communicated to him by Mr. Bednall and myself. The list contains the names of fifty-four gasteropods, twenty conchifers, and one palliobranch.

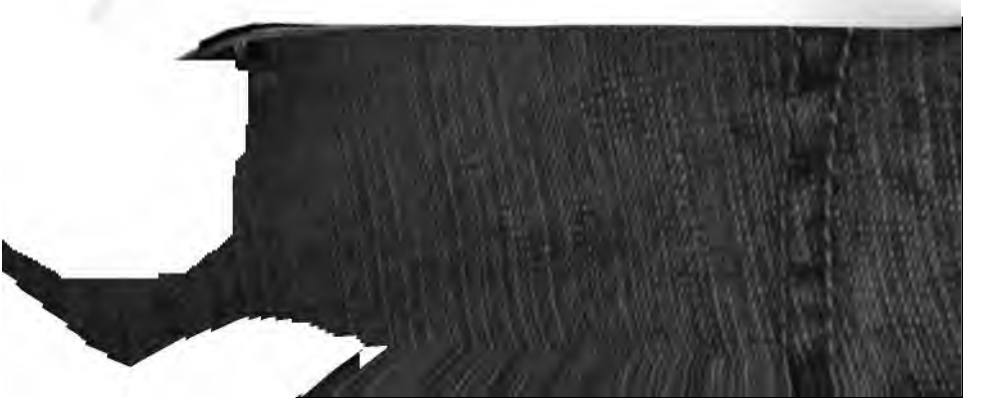
Mr. Petterd describes, in Journal of Conchology, April, 1879, seven new species of Tasmanian marine gasteropods, chiefly from Bass Straits.

Prof. Hutton, on the structure of Amphibola avellana (Annals and Mag. Natural History, March, 1879). Though the species, whose structure is, herein, so ably described, is not a member of our fauna, yet as it is allied to two very common forms of our maritime marshes and mud shores, the knowledge of the animal must supply very important data for comparison to those who occupy themselves with the physiology of our molluscs. The anatomy of *A. avellana* was first studied by Quoy and Gaimard, and published in the Zoology of the Astrolabe, vol. ii., p. 196, t.15, f.1-8. Those observers ascertained it to be a pulmoniferous snail, with the pulmonary cavity closed in front, and that the sexes are united in each individual. Professor Hutton's researches have enabled him to correct inaccuracies in several points communicated by the French naturalists; though corroborating their observations in the foregoing particulars. The systematic position of the genus has not been agreed upon by macalologists, and though Prof. Hutton does not compare the anatomy of this snail with that of other pulmonates, yet his very ample dissections will enable the systematist to bring the genus into closer relationship with those to which it is most nearly allied in structure.

Woodward (Recent and Fossil Moll., 1854) includes it in the Family Paludinidæ—a group of freshwater branchiferous snails, to which *Amphibola* is related by the form of its shell and operculum. Gray placed it amongst the true pulmonifera; Binney (1865) classes it under Pulmonata, suborder Thalassophila, which is characterised by "eyes sessile on the front part of the frontal disk, formed by the expanded tentacles." Only two families, *Amphibolidæ* and *Siphonariadæ*, are included. The dentition of *Amphibola* indicates, as represented by Professor Hutton, a nearer alliance to the inoperculate pulmonifera than to the branchiferous snails.

The carcinologist will find in the following recent papers much information respecting the crustacea inhabiting the Australian seas. With one exception, that of *Micippe parvirostris* (Miers) obtained at Port Lincoln, all the species referred to are not known to haunt our shores, though several occur in contiguous waters:—

"Revision of the *Hippidea*." By E. J. Miers (Journ. Linnean Soc., xiv., p. 312, 1879).



"New or Little-known *Maioid* Crustacea." By the same (Ann. Mag. Nat. Hist., July, 1879; also Journ. Linn. Soc., xiv., p. 634, 1879).

"On two new species of *Stenorhynchus*." By W. A. Haswell (Proc. Linn. Soc., N. S. Wales, iii., p. 408, 1879).

"On the Australian Species of *Penæus*." By the same (loc. cit., iv., p. 38, 1879).

"Contributions to a Monograph of Australian *Leucosiidæ*." By the same (op. cit. p. 44).

"A New Australian Sphæromid (*Cyclura venosa*)." By T. R. R. Stebbing (Jour. Linn. Soc., xii., p. 146, 1876). It has close agreement with our *Cymodocea armata*, but differs in some particulars, which are by the author considered to be of generic value.

The Australasian species of the Amphinomaceous Annelides have been increased by Mr. Haswell from eight to fourteen in number (see Proc. Linn. Soc., N.S.W., vol. iii., p. 341, 1879).

"New and Rare Hydroid Zoophytes (*Sertulariidæ* and *Thuiariidæ*) from Australia and New Zealand." By D'Arcy W. Thompson (Ann. and Mag. Nat. Hist., Feb., 1879; plates 16-19).

Nineteen species of four genera of these families are figured and described. Most of the species were obtained principally in New Zealand, but also from St. Vincent's Gulf, Bass Straits, Torres Straits. The author remarks that the Hydroids of Torres Straits and the Louisade Archipelago are singularly different from those of the southern and south-eastern region—*e.g.*, Adelaide and Bass Straits; and the forms inhabiting New Zealand are singularly distinct from the Australian species.

"Diagnoses of New Genera and Species of Hydroida." By Prof. Allman (Journ. Linn. Soc., vol. xii., p. 251; plates 9-28; 1875).

In this paper a large number of new Hydroid Zoophytes from many widely-scattered localities are described. Among these are five new *Sertulariidæ* and three new species of *Thuiariidæ* from New Zealand.

Mr. H. Carter, Contributions to our Knowledge of the Spongida (Ann. and Mag. Nat. History, April and May, 1879), describes and figures from South Australian waters, *Trachycladus laevispirulifer*, n. gen. et sp., *Amorphina stellifera*, n. gen. et sp., and *Stellettinopsis corticata*, n. gen. et sp.; and the following from other parts of the continent:—*Suberites fuliginosus*, n. sp.; *Stellettinopsis simplex*, n. sp.; and *Samus anonyma*, Gray, *Axos*, two sp.

In Phanerogamic Botany, additional species to the South Australian fauna, than are contained in the Flora Austra-

liensis, will be found in Baron von Mueller's Fragmenta Phytographiæ Australæ, the 90th fasiculus of which was issued in January, 1879.

The literature specially dealing with the fungi of Australia includes the following works omitted by me in my last address :—

Fries in Lehm, Pl. Preiss, vol. ii., pp. 130-140 (1846).

Berkeley in Hooker's Flora of Tasmania, vol. ii., pp. 241-282, plates 183-184 (1860).

Kalchbrenner and De Thuemen in "Grevillea," vol. iv., pp. 70-76 (1876) ; and in Flora ephemer, Ratisbon, No. 28 (1878).

An enumeration of the lichens in the British Museum, which were collected in 1802-5, during the notable voyage of Flinders around these shores, is published in the Proceedings of the Linnean Society, London, for 1879.

The literature of Australian Miocene Palæontology has been enriched by the publication of two papers by the Rev. J. E. T. Woods, describing some fossils from the Muddy Creek beds. See Proc. Linn. Soc., N. S. Wales, vol. iii., pp. 222-240, plates 20, 21 ; and vol. iv., pp. 1-20, plates 1-4, 1879. The number of species figured and diagnosed is 59 gasteropods and three bivalves.

A few of the more remarkable and larger species from the Victorian Miocene are dealt with in Decade VI., Pal. of Victoria, by Prof. McCoy ; these are *Lovenia Forbesi*, *Monostychia australis*, and the new species, *Clypeaster Gippslandicus* and *Hinnites Corioensis*. The same fasiculus contains the descriptions of three species of Cetotolites, or ear-bones of whales, probably *Ziphioid*, and other cetacean remains. These discoveries are interesting in connection with the presence of *balænoid* whales in the Murray beds, remains of which, including a perfect skull and a lower jaw, form part of the University collection.

Our Climate and Infant Mortality.

By S. J. Magarey, M.B.

My apology for bringing the subject of infant mortality before the notice of the Society so shortly after the recent discussion on the subject is that I do not think that sufficient attention has been directed to the climate as the cause of the excess of mortality in this colony. I propose to consider the question by means of the light supplied by statistics kindly furnished me by Mr. Todd, the Government Astronomer, and Mr. Cleland, of the General Registry Office. I propose to compare the variations of the deathrate with the variations of the temperature, rainfall, barometric pressure, evaporation, and humidity during the years 1873-1877, both inclusive, these being the only ones that afford the material for so critical an examination.

In connection with the subject of infant mortality several questions have been propounded:—

1. Is the deathrate of infants higher in South Australia than it is in the other colonies?
2. Granted that the rate is excessive, can any reason be assigned for this excess?
3. Is this excess peculiar to Adelaide, or does it extend to the colony generally?
4. What means can be adopted to reduce this waste of human life?

Before proceeding to consider the several propositions set forth, it is well first of all to observe that in 1874 and 1875 we were visited with a severe epidemic of measles which carried off 355 persons, 127 of whom were infants. This epidemic was closely followed by a severe one of scarlatina, which destroyed 484 persons, 58 of whom were infants. On this account, and remembering, too, that a period of five years is a short one from which to draw reliable conclusions, I expect to find that these conclusions will have to be somewhat modified as the data become more abundant and reliable; but as these researches seem to give us a clue as to the best means of combating the more serious diseases of infant life, I submit my results without hesitation, holding myself in readiness to modify them if it should seem to be necessary to do so.

I.—Is the Deathrate of Infants Higher in South Australia than it is in the other Colonies?

Dr. J. D. Thomas, at our recent discussion upon the subject, affirmed that the South Australian rate is often exceeded in other countries.

With regard to its relation to that of the other colonies, I have not been able to glean any information beyond that supplied by Mr. Hayter, in the "Victorian Year-Book for 1876."

From this it would appear that the infant deathrate per 1,000 births was—In Tasmania, 101; New Zealand, 102; New South Wales, 104; Queensland, 124; Victoria, 126; and South Australia, 156.

The rate here is higher than that of the other colonies, being half as much again as either that of New Zealand, Tasmania, or New South Wales. Allow me, however, to draw attention to one other fact, that is, the healthiness of South Australia for adults. I find in the same year-book the relative deathrates per thousand of the whole population of the various colonies thus tabled:—New Zealand, 12·7; Tasmania, 14·6; South Australia, 15·2; New South Wales, 15·4; Victoria, 15·9; Queensland, 18·2.

But I find after deducting from the total number of deaths of all ages those occurring under one year, that with regard to the rate of those *over* one year of age, the colonies stand in the following relative position:—New Zealand, 9·5; South Australia, 10·9; Victoria, 12·3; New South Wales, 12·6; Tasmania, 14·0; Queensland, 14·6. So that in the four years to the statistics of which I am able to refer, there is for those over one year of age only one colony more healthy than South Australia—viz., New Zealand—and that this colony is considerably more healthy than Victoria, New South Wales, Tasmania, and Queensland. Tasmania, which seems to be an unusually healthy colony for children, seems to be an unusually unhealthy one for adults, being almost as bad as tropical Queensland.

It is some consolation to know that if we can discover some means of getting infants through the first year or two of their lives, we are able to afford them a better chance of living to a good old age than any of the other colonies, with one exception, are able to do. I am, however, of opinion that the deathrate of 156 per thousand will prove higher than the average; for in three years out of the five it was lower than this—*e.g.*, in 1873 it was 140; in 1876, 149; and 1877, 140. It was the before-mentioned epidemics that raised the rate to such a height, it being in 1874, 171; and in 1875, 181. I think it probable that this epidemic of measles, coming as it did in the summer time, was more fatal than it was in the other colonies, which, I believe, it also visited.

II.—Granting that the Rate is Excessive, can any Reason be Assigned for this Excess?

Care must be taken not to ascribe our high deathrate to general causes which are operating in other colonies and countries without producing evidence to show that these causes are more active and potential with us. We may attribute it to dry nursing, improper dieting, disproportionate ages in parents, too early or too late marriages, parental carelessness and intemperance, parental ignorance and wickedness, stupidity of nurses, the *nimia diligentia medicorum*, or even to high doctors' fees; but unless we prove that these causes are more active and rampant here than elsewhere, we shall not clear matters very much.

Dr. McCarthy, in a paper read before the Medical Society of Victoria in 1864, drew attention to the high rate of infant mortality in that colony, and although he noticed that more than half the deaths of those under five years occurred in four summer months, he attributed nothing to the Victorian climate, but in a singularly weak way ascribed this excess to careless dieting, improper clothing, impure air, and, as he was speaking to a Medical Society, he emphasized the want of early and sufficient medical attendance, and that fatal proclivity that people have for securing the attendance of quacks and heterodox practitioners. But as he afterwards asserts that for sixteen years he began the treatment of nearly all diseases of infants with emetics, many people will be inclined to think that if his treatment were adopted by the members of the Society he was addressing, they could not delay too long in sending for this so-called skilled medical attendance.

There is not the least doubt that all these causes co-operate to destroy children, and in the case of improper dieting, it may be that the effects of improper feeding may be more marked in our hot climate where there is in early life so much tendency to gastric disturbance. Still, it is the duty of those that ascribe our high deathrate to these causes to prove that these causes are more active in this colony.

Bad drainage, again, undoubtedly has an injurious effect upon infant life, and in no other way can the high deathrate in the mining districts, in Hindmarsh, and in Port Adelaide be accounted for. But seeing that many country places are nearly as destructive to infant life as these badly-drained centres of population, and seeing that the babies die in weather that seems to be suitable to healthy adult life, I believe that time will show that bad drainage is not so efficient a cause as heat, and that though its influence is to destroy life, yet we must go beyond it to discover the true cause of our excessive mortality.

The cause of our excessive infant mortality I conceive to be

OUR CLIMATE—the hot dry air of our long South Australian summer.

Of the total number of deaths of infants in the province, the following proportions occur in the several months:—Most in March, 12·4; December, 12·1; January, 11·3; February, 10·8; April, 10·3; May, 8·3; November, 7; August, 5·8; June, 5·7; October, 5·5; September, 5·5; July, 5·3.

Five summer months head the list and five winter ones close it. As many babies die in four summer months—viz., January, February, March, and December—as in seven others. Twice as many die in January, February, March, and December as in June, July, September, and October.

Comparing the mortality with the temperature, we find the highest average temperature is in January. In this month the mortality is extremely high. In February both the temperature and mortality are slightly less. In March, the temperature is a little lower, whilst the rate of infant mortality attains its highest point. This must be either because the long-continued heat has worn the children out so that they cannot withstand the March temperature, or because the houses have become so thoroughly heated that though the air is not quite so hot, the temperature inside the houses and to which the infants are exposed, is just as high and even more close and oppressive.

From March, the temperature falls very rapidly during April, May, and June, and reaches its lowest point in July, and as it falls the rate of infant mortality follows *pari passu* in a remarkable way. It also reaches its lowest point in July.

In August, the temperature rises a little, and with it rises the rate of mortality. In September and October the temperature still slowly rises, but the rate of mortality remains almost stationary and not at all excessive.

In November and December, the temperature increases very rapidly, and with it the deathrate increases by "leaps and bounds," and in December becomes very high indeed.

From this sketch we conclude that the rate of mortality depends to a very large extent upon the height of the thermometer, and this with a regularity that is quite surprising, and to my mind proves that (excluding epidemics) the height of the thermometer during any given year will be the guide as to the amount of danger to which infants are exposed, provided that we make allowance for the humidity of the atmosphere. It is also noticeable that the thermometer begins to fall a little before the deathrate; it passes, but leaves a dreadful train to follow, and it begins to rise again a little before the deathrate increases, but as it rises the deathrate soon follows, showing that it is not exactly heat that kills, but continued heat.

WITH RESPECT TO HUMIDITY.—Upon this diagram I have

the line of humidity drawn alongside the others (in this case reversed) in order to show that whenever it is hot it is dry. The line of temperature and that of humidity (reversed) you will observe scarcely part, showing that the heat of our colony is almost invariably a dry heat, and that our cooler months are almost invariably moist—in this respect contrasting with Queensland. The hottest month is one of the driest, and the coolest is the most moist. The healthiest month is the most humid month, and the driest month is the most unhealthy.

RAINFALL.—I do not find that the rainfall, except in so far as it influences the humidity of the atmosphere, has much to do with the question of mortality.

EVAPORATION.—The only thing to notice is that the line of evaporation follows so closely that of temperature that no evidence can be obtained from it specially.

BAROMETRIC PRESSURE.—The healthiest months in the year for infants are as a rule those in which the barometer ranges the highest. The line of barometric pressure seems to follow somewhat closely that of temperature and humidity. When varies considerably from these, as in March, April, and M the line of infant mortality seems to follow that of temper in preference.

Another most interesting conclusion I arrived at following way:—After calculating the deathrate f month for infants, I did the same for children ove under five years of age, and also for those over fi age. I find that March proves most fatal to infan to children, and May to adults. February is infants, much less so to children, and it is the h in the year for adults. The healthiest mont infants is July, for children August, and for

The deathrate of *infants* seems to follow ture and humidity throughout the year; t to be still influenced by the temperatur point in summer and its lowest in wint so much influenced in this way as t rate of mortality in adults seems to year and attains the *lowest* point in

These observations seem to p accepted statement that our c healthy, is to be understood a whilst the healthiest time o young children suffer more it causes a perfect slaught that we are speaking of answer is that hot win ness that causes the m

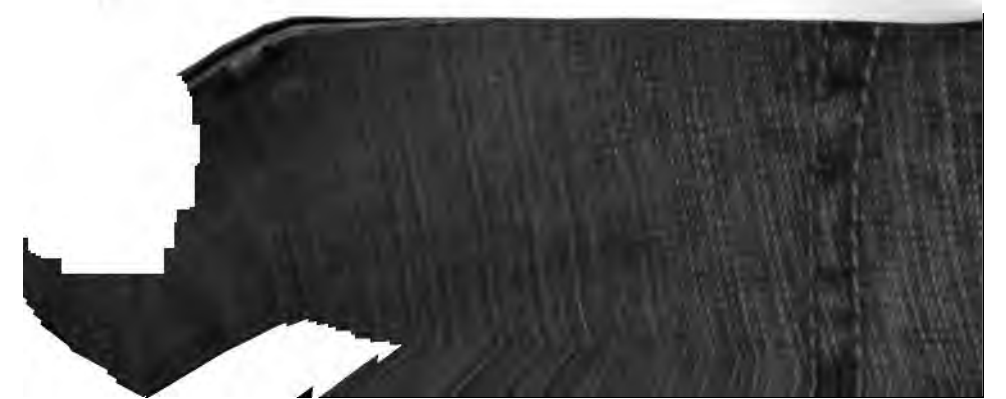
could be reduced to that of October (say 62 deg.) in the four summer months December, January, February, and March, no less than 300 lives might annually be saved. "A shipload of immigrants of the best type and not of the criminal class."

I have stated that the heat of South Australia is always a *dry* heat, and that this is the cause of our excessive mortality. This will appear more distinctly by comparing it with that of Queensland. In that colony the deathrate of infants is much lower than it is in South Australia, although the temperature of Queensland is some five or six degrees higher. But in Queensland there is a great deal more moisture in the atmosphere. Taking for example the year 1875, we find that the average temperature for that year in South Australia was 62·1—that of Queensland 69·3; the infant deathrate of South Australia was 181 per 1,000, that of Queensland only 152. Hence though the temperature was seven degrees more, the deathrate was 29 per 1,000 less. But the amount of humidity in Queensland was 77, while that of South Australia was only 60. And this difference in the amount of humidity is more marked in the summer months than in the year's average. In the four summer months January, February, March, and December, in 1875, the degree of humidity in South Australia was 43 per cent. less than that of Queensland, whilst its temperature was only 8 per cent. less. This certainly shows that it is not the fact of its being hot alone that destroys children, but that the heat is complicated with dryness.

III.—Is the Deathrate of Infants Higher in Adelaide than in the Colony generally?

The rate in the City of Adelaide is 216 per 1,000 births.
" " of the District of Adelaide is 176·7 " "
That of the colony, excluding Adelaide, 148 " "

In other words, nearly 50 per cent. more deaths occur in Adelaide in proportion to the infant population than in the rest of the colony. The deathrate of infants in the City of Adelaide as in the Province seems very closely to follow the line of temperature and humidity, but the most fatal month is not March but December, which is also the month in which there is the least humidity. The healthiest month is July, but the rate of mortality is higher in August than that of the Province seems to be. There are, however, two districts even more unhealthy for infants than Adelaide, viz., the District of Daly, including Wallaroo and Moonta, and that of Hindmarsh. In these two districts as many as 230 children in every 1,000 born die before they reach the age of one year. After these comes Port Adelaide with a deathrate of 180·6; then the District of Adelaide, 176·7; Mount Barker, 160·7; Burra,



155·6; Frome, 154·7; Kapunda, 148·4; Clare, 141·3; Hindmarsh, 129; Port Gawler, 128·2; Crawford, 128·2; Barossa, 124·8; Gilbert, 121; Strathalbyn, 118·4; Wellington, 109·2; Grey, 104·7; Robe, 104·3; Talunga, 103·2; Flinders, 101·5; Upper Wakefield, 101·4; Willunga, 100; Angaston, 95·9; Nairne, 94.8; Encounter Bay, 94·7; Morphett Vale, 86·3; and, lastly, Yankalilla, including Kangaroo Island, only 65.

As a general rule we find that the more we go to the north the higher is the deathrate of infants, the only exception being in crowded centres of population. Why the Districts of Daly, Hindmarsh, and Port Adelaide should be so fatal I cannot explain, unless the blame be laid upon the wretched drainage in these places. The most healthy district is Yankalilla and Kangaroo Island, and around the mouth of the Murray. I am not sure that we make enough use of Kangaroo Island as a health resort in summer time. Strange to say the mortality in the Mount Barker district is 160·7, while that of the District of Nairne, adjoining, is only 94·8. Perhaps more die in the winter in Mount Barker. I cannot find any means of deciding this point. Of all the districts north of Adelaide that of Angaston is the most healthy.

IV.—Can any Means be Adopted to Reduce this Excessive Infant Mortality?

This subject has already been fully discussed, and hence I shall be very brief. We have had suggestions by able men, given in lectures to the people, which, if they were acted upon, would much tend to reduce the rate, more particularly as regards the dieting, clothing, &c., and improvement of the homes. But if our babies die because the air is too hot and dry, we must modify our treatment accordingly, and I shall merely press this point briefly.

During the hot days every care should be taken to counteract the influence of this hot dry atmosphere. When the baby is ill it is the height of folly to throw open the door and window on an Australian summer's day to let in the hot wind under the erroneous impression that it is healthy. On the contrary by every possible means keep the air in your rooms cool. We cannot reduce the temperature of the colony, but we can reduce that to which our infants are exposed. Many ways suggest themselves at once for doing this, only one or two shall we notice.

A baby with little or no clothes on has a much better chance of living through a week of hot summer's weather than one "properly dressed." Too many clothes are put upon the child. The child could then be bathed two or three times a day in tepid or cold water without trouble. The child's head should

always be uncovered when it is in the house. These are but a few examples of the sort of treatment required to meet the case, but as I am not trying to write a popular lecture I leave many other points unmentioned.

But the main remedy, to my mind, is wherever practicable to spend the hot days, and if necessary the hot nights, in *underground* rooms. A reduction of temperature varying from ten to more degrees can be obtained by this means. I have often seen lives saved by this plan. It may be objected that as we have not deep drainage these rooms will be damp and unhealthy. No doubt to a certain extent they will be so, but you are flying from a great danger, and it is rational to risk a smaller one for safety. When we have deep drainage this objection will be removed. If it can be proved that by removing children to a cool temperature we can save their lives in summer, it is to be hoped the day is not far distant when benevolent persons will cause large, well-ventilated, cool resorts to be built in this city, to which babies may be taken during the heat of the day The place might be made attractive with fountains, flowers, &c. The wonder is that infants can last a single day in the miserable tenements of the poor in this city—the heat in them is often so intense.

As I do not wish to write a paper upon treatment, I shall conclude by noticing an argument that was supported by several medical men at our last discussion upon the subject. This was that the babies died because they could not perspire. The heat became intense, and a large amount of heat was absorbed, and as none of it could be rendered latent by the process of perspiration (as in adults) the blood became too hot to be compatible with the preservation of life. Now, I have been unable to discover any proof that infants do not perspire. 2nd. I have often seen them covered with perspiration; and, 3rd, the wonder is that any one could imagine that the process of perspiration could be suspended in a healthy subject, seeing that the sudoriparous glands are fully developed, the skin is soft, and the blood supply complete. It seems more probable that this heat acts directly upon the nervous system. It causes what has been called fluxionary hyperæmia of the brain, with consequent disordered function, and leading to the establishment of fatal forms of brain disease.

Again, by depressing the sympathetic and other ganglia, it arrests or causes the disorder of, secretion of various glands. In consequence of this the food taken is undigested and vomited, or passing into the bowels causes that diarrhœa which is the most obstinate of summer diseases to treat. The essence of all is *depression*. Hence so many deaths are ascribed to "atrophy and debility"—terms that should not, if possible, be

entered upon a certificate of death, and yet terms that are very expressive of the type of disease that has caused the necessity for a certificate.

If I have proved that the hot, dry air of our climate is the cause of the excessive mortality of infants in this colony my object has been attained, for I conceive that if this view be correct the first thing is to recognise it; and having recognised it, we shall be led to discover and to adopt measures that will be efficient in counteracting its influence. It is a subject of vast importance, and for this reason only am I justified in inflicting so many dry facts upon you.

AVERAGES (MONTHLY)

FROM 1873-1877 (inclusive).

	Deaths of Infants in South Australia.		Deaths of Children in South Australia under 5 years and over 1 year.		Deaths over 5 years in South Australia.		Deaths of Infants in City of Adelaide.		Barometer.	Temperature	Evaporation	Humidity.	Rainfall.
	Total each month for 5 years.	Percentage per month.	Total each month for 5 years.	Percentage per month.	Total each month for 5 years.	Percentage per month.	Total each month for 5 years.	Percentage per month.					
Jan. ...	685	11·3	205	8·2	136	8·1	137	12·8	29·816	74	10·885	48·3	·367
Feb. ...	659	10·8	201	8	121	7·2	138	12·8	29·873	72·7	8·557	49.8	1·266
March .	756	12·4	252	10·2	150	8·9	140	13	29·968	69·7	7·105	52	1·373
April ...	629	10·3	247	9·9	149	8·9	78	7·2	30·007	63·7	4·383	61·4	2·025
May ...	505	8·3	198	8	154	9·2	66	6	29·964	56·9	2·841	70·6	4·137
June ...	349	5·7	211	8·5	137	8.2	59	5·5	30·054	52·7	1·703	74·8	2·173
July ...	324	5·3	190	7·6	137	8·2	40	3·7	30·144	50·4	1·745	76·4	1·980
Aug. ...	354	5·8	165	6·6	150	8·9	75	6·9	30·001	53·9	2·674	71·2	2·499
Sept. ...	334	5·5	169	6·8	132	7·8	54	5	29·974	55·6	3·487	67·2	2·067
Oct. ...	337	5·5	200	8	135	8·1	53	4·9	29·936	62·2	5·938	58·4	1·653
Nov. ...	425	7	193	7·7	136	8·1	75	6·9	29·869	64	7·593	52·8	·662
Dec. ...	735	12·1	262	10·5	141	8·4	165	15·3	29·842	71·3	10·243	46·6	·934
Total .	6,092		2,493		1,678		1,080						

THE SOUTH AUSTRALIAN STATISTICS OF CONSUMPTION.

By JOSEPH C. VERCO, M.D.

It has long been known that the prevalence and fatality of consumption of the lungs vary greatly at different places and under different climates. But there does not seem to be any one climate which specially opposes the disease. It has been shown to be almost unknown in some of the cold and stormy islands off the western coast of Scotland. The number of invalids with pulmonary affection who yearly flock to the temperate regions of Italy and Southern France testify to the popularity of the impression that a mild, genial atmosphere is highly beneficial. Yet our southern sub-tropical colony does not fail to attract a host of sufferers seeking amidst all the discomforts of dry and dusty heat the cure for their complaint, while there are not wanting those who extol the rarified and bracing air of lofty mountain chains as *par excellence* the remedy for phthisis. It would appear, then, to be almost impossible to decide from the physical or meteorological data of a given locality whether it would prove beneficial or otherwise. A guess might be made either right or wrong. The appeal must be made to the statistics of the place; whatever the *à priori* conclusion may be, the real decision must rest upon the death returns. In spite of all we hear in depreciation of statistics to the effect that anything may be proved from them, it is certain that very little could be proved without them—all that could exist would be a mere floating, unsatisfactory general impression. I wish to point out what, that is fairly definite, can be learned about consumption in South Australia from this source.

Where the materials from which deductions are to be drawn respecting a complaint consist entirely of death returns, the study of phthisis presents an advantage over that of almost every other affection, viz., that so large a proportion of the patients attacked ultimately die from its ravages. I would not be understood to suggest that it is incurable—it most certainly *is* curable; still so many of those seized are eventually destroyed, that the mortality tables give a very approximate idea of the prevalence of the disease.

It is only during the last five years that the annual returns of vital statistics have been issued in their present fulness; so that it is to these five years—1873-77—that our attention must be confined, and from which our deductions must be drawn. Because our community is so small, numbering less than a quarter of a million persons, and because the reports extend over so few years, it may be suggested that the figures are not large enough to permit of any very certain conclusions, inasmuch as a few exceptional cases might lead to generalizations, which but for these stray cases would wear a very different complexion. Without doubt this may be in degree true. But these statistics constitute almost all the material at present at our disposal; and we must be content to reduce them, if we would learn anything about the disease as it now exists; and leave the confirmation or disproval of our conclusions until our population and our returns furnish us with more extensive data. There are several points, too, which seem plain and prominent on the very face of our statistics; and it is quite improbable that future returns will prove them temporary or circumstantial.

Because our attention will be almost wholly confined to these reports, we shall be unable to touch upon many questions of interest, much less to decide them; since no hint respecting them is contained in our tables. For example, of what moment would it be to determine whether the acclimatised immigrant is more predisposed to the disease than the native-born South Australian; whether the natives of the second generation are more liable than their parents; whether, in fact, the South Australian race is becoming more obnoxious to it, and in that sense is constitutionally degenerating, or is acquiring a resisting power, and so developing. In the death certificates provided by Government for the use of medical men, there is provision made for obtaining the information requisite to decide the first query. But no return founded upon this information is issued, owing, I believe, to the fact that the information is not supplied by the medical men. Now, it will be seen as we proceed that more than one question of great importance might be satisfactorily replied to did we know how long the deceased had been in the colony. This is the point on which we require and might have had returns, on which it was intended we should have had—as witnesseth the blank space in the death certificate.

Extent of the Disease.

The first question that naturally arises is to what extent does consumption prevail in South Australia, and how does the mortality here compare with that elsewhere? During the five

years 1873-77, 969 deaths have occurred in the province. Estimating the population at 210,516, the mean for the five years, we obtain an annual deathrate of ·920 per 1,000 for both sexes at all ages.

From the Thirty-ninth Annual Report of the Registrar-General of England we learn that the deathrate from consumption, during the twenty-five years 1850-74, was 2·5672 per 1,000; and during the five years 1870-74, 2·2828 per 1,000. So that the mortality there is from 2½ to 2¾ times greater than here. This is a result highly favourable to our colony, and proves that there are in South Australia certain circumstances which do not exist in England, or exist in much smaller degree, and which confer upon the people some sort of immunity from this affection. Whether those circumstances are the healthier constitutions of the earlier settlers and the later immigrants, the absence of overcrowding and poverty, the larger proportion of agriculturists, certain social or moral conditions, or climatic influences, we cannot just now stop to inquire. We simply state the fact that the deathrate in England from phthisis is from 2½ to 2¾ times higher than here. Our statistics, then,

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1873	198,257	153	·77
1874	204,883	179	·87
1875	210,699	208	·99
1876	224,488	226	1·00
1877	236,864	203	·86
	1,075,191	969	·898

This table gives the estimated population of South Australia of both on the 31st of December of each year, the absolute number of deaths phthisis, and the rate of mortality to 1,000 of living persons. The rate, the mean of the five years, is ·898. As the population reckoned that of the *last day* in each year, and as this is greater than the m lation for the year, it is evident that the deathrate from cons slightly lower than it should be. To be as accurate as possibl mean between the population on the 31st of December for that of the last day of the previous year, and take this as the mate population. For 1873, suppose an increase during this that of 1874, viz., 6,626, and subtract the half of this amou 198,257, the population of December 31st, 1873.

1873 ..	..	..	..	..	..	
1874 ..	..	..	..	..	..	
1875 ..	..	..	..	..	..	
1876 ..	..	..	..	..	..	
1877 ..	..	..	..	..	..	

The total population for the five years is thu 1,052,579, and the deaths remaining the sa people is raised from ·898 to ·920. This may an estimate as can be obtained of the m Australia—·920 per 1,000 for both sexes, at

support strongly the general impression afloat that South Australia is a very favourable place for those who are predisposed to this disease, and negative such assertions as that phthisis "is very common and malignant in the South Sea Islands, Australia, and New Zealand,"* at least when the comparison is with its prevalence and fatality in England.

Is South Australia thus comparatively free from consumption *alone*, or is there the same proportional freedom from disease as a whole? It is of course conceivable that there might be certain conditions antagonistic to disease generally, and not to phthisis specially. If this were the case, then on comparing the deaths from consumption here with those from all diseases, the ratio would be the same as that of the phthisis mortality to the total mortality of England. If, on the other hand, there were in South Australia a special immunity from this affection, then the ratio here should be less than that at home. And so it is. During the seven years 1871-77, the ratio of the deaths from consumption to those from all diseases was 5·764 per cent., while the English returns show the proportion of 10·2 per cent. Hence, we conclude that in South Australia there is a special immunity from phthisis as compared with all other disease; that there are certain conditions which exert an influence twice as favourable to life in the case of consumption as in other disease; that South Australia is a residence specially for those of consumptive tendencies.

Perhaps the most important inquiry that arises among the many regarding our mortality from consumption is this—Is the deathrate rising or falling in South Australia? Is the above shown favourable state of affairs merely temporary, or have we ground for hoping that our mortality may remain permanently low, or even be reduced? This question becomes more interesting from the fact that may be observed in the

1871	..	..	..	157	..	2,378	..	1 in 15
1872	..	..	..	146	..	2,896	..	" 19·8
1873	..	..	..	153	..	2,631	..	" 17·19
1874	..	..	..	179	..	3,406	..	" 19
1875	..	..	..	208	..	4,186	..	" 19·8
1876	..	..	..	226	..	3,550	..	" 15·7
1877	..	..	..	203	..	3,225	..	" 15·9
				1,272		22,222		" 17·35

This table gives for seven years the number of deaths from phthisis of both sexes and all ages, the number of deaths from all diseases, and the ratio which those bear to these. The result is 1 in 17·35, or 5·764 per cent. The English returns for 1876 show that 49,795 persons died of consumption and 510,315 from all diseases; so that 10·2 per cent. were accounted for by this complaint.

* Hirsch, cited in Waters's "Diseases of the Chest," page 223.

English returns. These make it evident that for the last five-and-twenty years the deathrate from consumption has steadily decreased during every quinquennium from 2·8112 for 1850-54 to 2·2828 for 1870-74. By some means, either municipal hygienic measures, or personal, direct medical treatment, or otherwise, fewer persons, proportionally to the population, are dying of phthisis than formerly in England.

In England, the deaths were per 1,000 from phthisis—2·8112 for 1850-54, 2·6476 for 1855-59, 2·5664 for 1860-64, 2·5278 for 1865-69, 2·2828 for 1870-74.

What is the state of affairs amongst us? Had the statistics been investigated at the end of 1876, one would have been inclined—would have been forced—to admit the very disagreeable fact that the rate was rising so rapidly as to be quite alarming, and so steadily as to furnish ground for fear that at no very distant date it would even reach that of the countries at the antipodes. Not only have the deaths been increasing yearly with the increase of population, but out of proportion to it; so that the mortality from 1873 to 1876 has risen from ·77, through ·87, ·99 to 1·00 per 1,000.

However, in 1877, although the population had increased by 12,000 souls, the deaths from phthisis had absolutely diminished, and were even fewer than in 1875, when the population was less by more than 24,000 persons. The ratio for the year was thus reduced again to that of 1874. This circumstance might have encouraged us to hope that the steadily-increasing mortality of the previous four years was but temporary, and did not indicate a rapid and continuous progress of this scourge of humanity. But I find from the monthly returns of 1878 that during that year there were 267 deaths from this complaint, while the population at the end of December, as nearly as I can calculate it from the monthly means, was about 250,000, which gives a deathrate for the year of about 1·067. This is higher than that of 1876, when it stood at 1·0067; higher, in fact, than in any other year of which I have returns. So that it would seem that the fall in 1877 was an exceptional circumstance, and that the hope excited by the low mortality of that year is completely dispelled by the returns for this; and we must, however we may account for it, reconcile ourselves to the uncomfortable fact that our mortality is increasing, and that it has increased to nearly half as much again as it was six years ago. This is brought into bolder relief by contrasting our rising deathrate with the falling mortality of England. How is this growing fatality to be explained? Surely our climate cannot be changing to such a degree as to account for the rise? Are South Australians degenerating to this extent? Are we importing a

race of immigrants constitutionally so unsound? Are our sanitary arrangements becoming so exceedingly defective? Is our social or moral condition becoming so deteriorated? Or is it that the diminution in the mortality at home and its increase here are to be attributed to the increased facilities for travel, in consequence of which more invalids are yearly leaving the old country and seeking in climates accounted more favourable to their constitutions health and longer life. To this explanation, in part at any rate, I am inclined, viz., the exodus of the phthisical from England in search of cure, and the influx of such persons into our colony, not only as voyagers at their own expense, but as immigrants introduced by the Government. This is a matter that might be very approximately settled by a careful filling up of the space provided in the medical death certificates, whereby we should learn how long each individual had been in the colony, and how much of the mortality should be debited to South Australia, and how much to other countries. Until this question is decided, and unless this suggestion is confirmed, the prospect for the phthisical in South Australia is gloomy. A growing cloud threatens to obscure the brightness of our skies from which the consumptive has been accustomed to draw some rays of hope.

Having demonstrated above that fewer persons die of consumption here than in England, one is curious to know whether among consumptives life is lengthened in our colony or not. In England the mean duration of life among those who succumbed to this disease in 1876 was 33 years and 2 months. In South Australia during the five years it was 31 years and 10 months. The difference is in favour of England to the extent of one year and four months. It appears, then,

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The mean duration of life has been thus calculated:—In England 1,242 males died under 5 years of age. It would be manifestly wrong to consider them as all dying at five; this would give too high a mean, so it is taken at 2½. The 1,242 then lived a total of 3,105 years. 418 died between 5 and 10; their average was 7½; their total age 3,135, and so on. Accordingly the years lived by the males and females who died of phthisis in England in 1876 are as under:—

25,127 males	lived 872,736 years,	or 34 yrs. 7 mos.	per m.
24,668 females	" 777,691 "	" 31 yrs. 1 mo.	" f.
49,795 both sexes	1,650,427 "	" 33 yrs. 2 mos.	

In South Australia the totals are as follows:—

517 males	lived 17,691 years,	or 34 years 3 mos.	per m.
450 females	" 13,009 "	" 28 years 11 mos.	" f.
967 both sexes	30,691 "	" 31 years 9 months.	

When grouped together in the same periods as the English deaths the mean age for both sexes is found to be 31 years 10 months.

be more than four years less than that of the persons living in England in 1876. Our colony is very young, not fifty years of age: our community is young, time has not been allowed even for our early settlers to attain to extreme years. There is a constant immigration of persons, none of whom are above forty years of age, and so it comes to pass that our mean age is four years less than that of the mother country. But the shorter duration of life is only one year and four months. So we may believe that this is fully explained by that, and more than explained; and that although our mean duration of life in those who die of phthisis is sixteen months less than at home, yet it is quite possible, nevertheless, that we may be attacked at a later rather than an earlier age, and our duration of life after invasion, both among those who are attacked here and those who contract the complaint elsewhere, may be longer than in England. There is one other circumstance which may be mentioned, too, by way of explanation and palliation of our lower age at death. It is this:—There is confessedly considerable immigration of people in the early stages of consumption from Britain to these colonies. These come out here and die. Now it seems very natural that these should consist almost entirely of the young. For when men have attained to middle age they are engaged in business pursuits which to leave would be to ruin, or are surrounded by families, to whom domestic necessities and domestic affections inseparably bind them. But the young, more sanguine of benefit than the old, more attracted by the novelty of travel, less fettered by business and by family ties, find it more convenient and congenial to take the voyage. They come out here, and they die. The older die at home. These raise the mean duration of life in phthisis in England—those lower it in South Australia. Again we require the blank space filled up in our death certificates, that we may know among those who die at early ages, how long they have been in the colony.

Influence of Season.

If we prepare a table showing the number of deaths which have occurred during each of the twelve months of the years 1872-77 we find that in January 84 died, in February 71, in March 102, in April 113, in May 102, in June 85, in July 89, in August 102, in September 93, in October 105, in November 90, and in December 77. Whence it appears that the fewest deaths during any three consecutive months occurred in December, January, and February, with a total of 232; most deaths in the next three months of March, April, and May, viz., 317; during the next quarter, June, July, and August, the

total is 276, and during September, October, and November 288. The hottest three months in our year are December, January, and February, the coldest three June, July, and August, while the other quarters are intermediate in their temperature. Therefore the smallest number of deaths occur during the hottest three months, our summer; the next smallest during the coldest three, our winter; then during the three spring months; and the largest number during the three autumn months. So it seems that our southern summer, with its heat, is by no means inimical to the phthisical patient, but manifestly beneficial; that the settled cold of our winter is not to any great degree unfriendly; that the seasons most to be dreaded are the milder ones, the transition periods; and that the quarter of falling temperature, the autumn, is more disastrous than the spring, with its gradually increasing heat. Now this, I imagine, though it must accord with the experience of medical men—for our statistics are but the embodiment of such experience—is almost the reverse of what we should have been inclined to prophesy. We should have anticipated that

Deaths from Phthisis in South Australia in the 12 Months.

	Jan.	Feb.	March	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1871	..	..	..	..	..	..	..	..	..	..	..	10
1872	13	8	14	17	13	9	9	15	14	11	13	10
1873	13	14	15	7	16	8	13	18	13	19	13	4
1874	10	6	20	28	13	13	8	14	12	17	19	20
1875	16	16	19	25	18	18	14	20	16	15	15	16
1876	15	12	13	16	23	20	29	19	21	28	13	17
1877	17	15	21	20	19	17	16	16	17	15	17	..
Total ..	84	71	102	113	102	85	89	102	93	105	90	77

Deaths from All Diseases in South Australia in the 12 Months.

	1871.	1872.	1873.	1874.	1875.	1876.	1877.	Total.
January	..	284	269	237	461	264	339	1,854
February	..	211	217	210	398	317	324	1,677
March	..	328	276	298	495	325	367	2,084
April	..	329	283	290	462	272	364	1,950
May	..	254	225	280	402	286	282	1,729
June	..	248	195	235	311	276	228	1,488
July	..	215	212	177	290	322	199	1,415
August	..	225	192	237	288	362	197	1,496
September	..	184	208	251	255	256	196	1,350
October	..	165	169	315	246	271	211	1,377
November	..	216	184	385	274	246	235	1,540
December	232	247	251	546	259	353	..	1,878

the genial autumn and spring would have been most beneficial, and the extreme seasons the most baneful. But so it is not. The hot, dry, dusty summer is the most propitious of all, and next our winter, with its sub-tropical rains.

Now it may be suggested that since this is a chronic and not an acute disease, although during the autumn the mortality is highest, this may be the effect of the excessive heat of summer; the effect not being perceptible until after the lapse of some months, because the heat does not kill the phthisical patient at once, but only after an interval. This suggestion is plausible, and moreover it derives no litttle support from the figures, for we might thus explain that it is not only the great heat of summer that produces the great mortality of autumn, but that the milder autumn weather accounts for the smaller deathrate of winter, the comparative severity of winter again the increased mortality of spring, and the genial influences of spring the minimum mortality of summer; allowing thus three months for the production of the effect by its cause. But although its ingenuity is attractive, this theory must not, I think, be entertained. Rather than receive it, we must lay the statistics aside, with the impression that we can come to no certain and definite conclusion about the influence of season. For how do we know what length of time must elapse before the deleterious influence acting on the phthinode will kill? Why should it be three months, and not six? Why should we suppose that the higher mortality of the autumn is the expression of the baneful influence of the summer, manifested after an interval of three months, rather than that the lower mortality of the winter is the expression of its beneficial influence visible after six months? No; unless we conclude that the small summer deathrate is due to the summer, we must abandon all conclusion on the effect of season. Did we find in reference to phthisis a state of things similar to what we observe in considering the question of infant mortality, we might admit the hypothesis perhaps. There we see the deathrate *increasing very rapidly* during the hot months of December, January, and February, to a high figure, but reaching the maximum only in March, when the temperature has begun to fall, and then decreasing as the heat continues to fall during the succeeding months. In such a case it is admissible as an explanation, and highly probable, that the maximum in March is the climax of the ill effects of the high temperature of December, January, and February, and is not due to the March temperature alone. But the case is very different in regard to consumption. If the summer influences were deleterious, we should at least expect that during the summer the deathrate would increase to some extent, even though it should

reach its acme in the autumn. But the reverse takes place. During our quarter of extreme heat our deaths are fewest; therefore, we cannot suppose our summer is inimical, but friendly, to the patients, and must credit it with its own minimum mortality. And when we review the cases that have fallen under our notice, we must remember how these patients nearly always enjoy the hot weather more than any other season of the year, and require medical services less.

If we throw the monthly deaths from phthisis into the form of percentages, and so facilitate a comparison with the monthly mortality from all diseases, the special influence of the summer upon consumption becomes more evident.

208 per 1,000 of the deaths from phthisis occur in December, January, and February.

285 in March, April, and May;

248 in June, July, and August;

259 in September, October, and November.

273 per 1,000 of the deaths from all causes occur during December, January, and February;

290 during March, April, and May;

222 during June, July, and August;

225 during September, October, and November.

Whence it appears that the deaths from consumption are during the summer 8 per cent. less than during the autumn, 4 per cent. less than during the winter, and 5 per cent. less than during the spring. On the other hand the deaths from all causes during the summer are 2 per cent. less than during the autumn, 5 per cent. more than during the winter, and 6 per cent. more than during the spring. So we conclude that the summer weather, which is maleficial as regards disease in general, causing an increased mortality of 5 per cent. over that of winter, is beneficial—specially beneficial—in phthisis, causing a lowered deathrate of 4 per cent.

Can we explain to what this lower mortality in summer is due? Not altogether satisfactorily. May it be due to the heat? Probably to some—to a large extent. The fact that the minimum deathrate occurs in summer points to an antagonism between heat and phthisis. But heat will not wholly

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The mean monthly temperatures for the ten years 1865-74 are as follow, with the quarterly means:—

Dec., Jan., Feb.			Mar., April, May.			June, July, Aug.			Sept., Oct., Nov.		
71·4	73·7	73·8	70·1	64·6	58·2	54·4	51·5	53·7	56·9	62·5	66·5
218·9			192·9			159·6			185·9		
72·3			64·3			53.2			61.0		

The quarterly deathrates from phthisis are—

208	285	248	259

account for the seasonal variations, inasmuch as the thermic chart does not indicate the same fluctuations. Although the minimum deathrate coincides with the maximum temperature for the quarter, that is the only correspondence—the minimum temperature does not coincide with the maximum deathrate, nor the falling and rising heats with increasing and decreasing rates. Therefore, heat alone will not explain the variations.

Nor will the rainfall, nor the humidity of the atmosphere, nor any combination of these, since they follow very closely the thermic curves, only in a reverse direction.

Nor will the diurnal range of temperature—the change that occurs from heat to cold daily—inasmuch as the mean monthly diurnal range corresponds with the ordinary temperature chart, being greatest in the hottest quarter, and *vice versa*.

One circumstance that I would suggest is the settled or unsettled state of the season. During the summer we experience a settled state of warm, dry weather. At this time we get the minimum of deaths. During the winter we have a settled state of much cooler wet weather, but not extremely cold. This is not so beneficial. During the autumn and the spring the weather is more fluctuating, days of great heat alternating with others of rain storms and much lower temperature. Now it seems very possible that these milder seasons, because they are so much more uncertain, may be those which, in advanced phthisis, produce such an exacerbation of the disease as is sufficient to cause death.

Influence of Sex.

Has sex any influence upon phthisis in South Australia? Yes, in more respects than one.

1. As regards susceptibility to the disease, we find that during the five years there have occurred 517 deaths among males, and 450 among females. When we examine the proportion of men and women in our community we find that there are 449,633 males for every 417,859 females, or 5·17 men

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The estimated populations in South Australia are as under:—

1873	..	..	101,743	males, and	96,514	females.
1874	..	..	104,995	"	99,888	"
1876	..	..	116,503	"	107,985	"
1877	..	..	126,392	"	113,472	"
			449,633		417,859	

In England in 1876 there was a population of 11,801,633 males and 12,442,377 females, while the deaths from phthisis were 25,127 males and 24,668 females. But if the deaths were proportional to the populations, 26,491 women ought to have died instead of 24,688, or 145 women instead of 135. So the populations being equal, 145 men die for every 135 women; or men are more susceptible to the extent of 1-13·5 part.

for every 480 women. Therefore, if consumption were equally an affection of both sexes, for every 517 males that die, there should be 480 females; but there are only 450. So that phthisis attacks men more frequently than women, according to the ratio 480 to 450, or 16 to 15. Men are to the extent of one-fifteenth part more liable to this disease than women. The same is found to be the case on application to the English statistics. In 1876, 145 men died for every 135 women; so that the mortality among males ruled higher by one-thirteenth to one-fourteenth part. This is not very different from the one-fifteenth part observed out here. It has been suggested by a writer (Dr. Bird) that this greater susceptibility of men influences the comparative deathrate in England and South Australia. For since men are more liable than women, that country where the men preponderate will, other circumstances being equal, show a heavier mortality. Now, whereas the males predominate in this colony, in the mother country the reverse occurs; and therefore in contrasting the climates in regard to their desirability in this disease, something should be subtracted from our mortality, or added to that of England, so as to compensate for the effect of the difference in the proportion of the sexes. This is theoretically true enough, but practically it may be ignored; for I find that if the proportion of the sexes in England were altered so as to be the same as ours, there would be an increase in the deaths from consumption of only 4·7 per million of population. Thus with the English population and deaths from consumption as above, the mortality would be 2·0539 per thousand. If the proportion of the sexes were the same in England as here, and the number of women the same as in 1876, the men would be 13,388,495, the male deaths 28,506, and the total deathrate from phthisis 2·0586, or an increase of only about 4·7 per million of population.

When such a fact as the above is elicited, the question naturally arises, How does sex thus modify the deathrate? Why is it that men are more liable to die of consumption than women? Why should not women die rather than men? Many answers might be suggested. But our statistics furnish us with an explanation, which I am inclined to adopt, namely, the shorter duration of the reproductive function in females than in males. The grounds upon which this theory rest will be shown a little further on in this paper.

2. Sex influences phthisis in South Australia in respect to the duration of life. The mean duration of life among men who die of consumption is 34 years and 8 months, and among women 28 years and 11 months; so that our females may be said to die about five years and a half earlier than our males.

In England in 1876 the mean duration of life was among males 84 years 8 months, and among females 81 years 1 month; from which we gather that our men die at almost exactly the same ages as they do there, but that our women do not live so long by a little over two years. This last-mentioned fact has been already shown to be more than explained by the higher average age of the living population in England, the women of England being full five years older than those of South Australia. Can we in the same way attribute the earlier deaths among the females than among the males out here to the same cause, namely, that the average female age is lower than the average male? No, not so as to furnish a full explanation; for whereas the average age of our women in 1876 was 21 years and 11 months, that of our men was only 23 years and 8 months, giving a difference of only 1 year and 9 months. But the difference in the age at death from consumption is five years and four months; therefore women are certainly attacked and destroyed at an earlier period than men. May this be accounted for by their earlier development?

Influence of the Reproductive Power.

From consideration of our statistics we may observe that consumption is, broadly speaking, chiefly a disease of developed mature life, more strictly that it is a disease of the reproductive period of life.

If we examine a table of the absolute deaths from phthisis during the five years, among both sexes, grouped under the different ages, we find that the mortality in childhood not very great during the first year of life, sinks to its minimum between the ages of three and four. From the fourth year upward it rises through each quinquennial period to reach its maximum between 20 and 25 years, and then falls gradually and regularly to the extreme of life. If we combine these periods so as to form groups of 15 years each, there appear 97 deaths in the first, 370 in the second, 318 in the third, 147 in

Deaths from Phthisis during the Five Years 1873-77.

Under	Males.	Females.	Total.	Under	Males.	Fema'es.	Total.
1 year	12	8	20	35 years	62	57	119
2 years	7	4	11	40 "	69	48	117
3 "	3	1	4	45 "	47	35	82
4 "	0	1	1	50 "	41	16	57
5 "	5	4	9	55 "	37	14	51
10 "	7	6	13	60 "	26	13	39
15 "	11	28	39	65 "	19	3	22
20 "	45	75	120	70 "	5	4	9
25 "	59	69	128	75 "	2	1	3
30 "	60	62	122	80 "	0	1	1

Totals—Males, 517; females, 450.

the fourth, and 34 in the fifth. It is during the second and third periods that the great bulk of people die, between the ages of 15 and 45, more than twice as many as during all the other periods put together. It seems that having escaped the trying years of infancy, as development proceeds from 4 to 5, from 5 to 10, from 10 to 15, from 15 to 20, so the deaths increase; that is to say, the nearer maturity is approached the greater does the liability become. It is between 15 and 20 years that full growth is in a large proportion of cases attained, hence we find that here the mortality almost arrives at its maximum; but not quite. It is not until from 20 to 25 that this is reached. From this period until 40 there is very little fall, the deaths remain nearly the same; but after this, during the decline of life, down to extreme years, the mortality most markedly diminishes; so that from a glance at the table of absolute deaths we might conclude that as development proceeds the deaths from phthisis increase, when full maturity is attained the deaths are most numerous, while the period of prime continues the deathrate remains almost unchanged; and when degeneration sets in and progresses then comes a decline in the deaths.

If we examine separately the statistics of the two sexes, we shall find this statement curiously confirmed; for since women develop more rapidly than men, and come to maturity sooner, we should expect to find the deaths from phthisis increasing earlier and increasing more quickly among females than among males. And such is the case. From 4 years to 5 five males die and four females; from 5 to 10 seven males and six females; that is during the period of life at which the development of both sexes is about the same, the deaths from this disease are about equal. But from 10 years to 15 only 11 males die and 28 females—between twice and three times as many; from 15 to 20, 45 males and 75 females; combining the figures from 10 to 20 years, 56 males die and 103 females, or nearly twice as many women as men. This more rapid attainment of maturity by females is quite commonly recognised, and is so markedly coincident with the rapid increase in the mortality of consumption as to present itself very prominently in the relation of cause. Nor is this a seeming coincidence from the table of the absolute mortality. It may be traced quite as markedly when we draw up a table showing the proportion which the deaths from phthisis at the various ages bear to the populations at those ages, according to the census of 1876. For instance, we see at once the great disparity between the deathrate 1·022 of 15 to 20 years for both sexes, and 0·284 of 10 to 15; and the increase of 0·284 from 10 to 15 over 0·084 of 5 to 10 years. So also we cannot but be struck with the

higher rates of mortality among the females between 10 and 20 years, viz., 0·41 and 1·27 per 1,000, as compared with 0·16 and 0·77 among the males for the same period. In fact, this table confirms most strongly the proposition that consumption is chiefly a disease of maturity, and hence increases as development progresses, augments greatly on the accession of puberty, and rises almost to its maximum as soon as full physical development is attained. But it is noticeable that although from the table of absolute deaths we might have deduced the proposition that it is more a disease of the prime of life than of the degeneration period, here we should have been wrong, since this table of the relative deathrate shows that the falling off after the age of 40 is almost though not quite accounted for by the smaller population at this advanced period, and that consequently the decline of life enjoys in only an insignificant degree any exemption from this disease.

If now we consult a series of tables giving the deaths at different ages from all diseases, and the ratio which the deaths from phthisis bear to those, we find that consumption is especially a disease of maturity, and in this respect is unlike disease in general. If it were like other affections in reference to the time of life at which its attacks occur, then the ratio of its deaths to those from all complaints ought to be the same for each period of life. But it is far otherwise; for whereas between the ages of five and 10 only 16 die of consumption out of every 1,000 deaths, between 10 and 15 years 38 die, or twice as many; while between 15 and 20 years 232 out of every 1,000 deaths are due to that cause, or six times as many as are accounted for during the previous quinquennium. But the

Population of South Australia as per Census of 1876.

Under	Males.	Females.	Total.	Under	Males.	Females.	Total.
5 years	15,762	18,852	34,614	50 years	4,709	3,779	8,488
10 "	15,552	15,232	30,784	55 "	3,689	3,051	6,740
15 "	13,819	13,696	27,515	60 "	2,873	2,227	5,100
20 "	11,691	11,784	23,475	65 "	1,995	1,755	3,750
25 "	9,865	9,183	19,048	70 "	1,307	1,044	2,351
30 "	8,250	6,980	15,230	75 "	754	620	1,374
35 "	7,555	6,320	13,875	80 "	360	333	693
40 "	6,537	5,603	12,140	85 "	182	174	356
45 "	5,510	5,101	10,611				

Ratio of Annual Average Deaths per Thousand of Population.

Under	Males.	Females.	Total.	Under	Males.	Females.	Total.
5 years	·34	·19	·26	45 years	1·7	1·37	1·546
10 "	·09	·078	·084	50 "	1·74	·84	1·342
15 "	·16	·41	·284	55 "	2·01	·91	1·521
20 "	·77	1·28	1·022	60 "	1·81	1·17	1·528
25 "	1·19	1·5	1·344	65 "	1·90	·84	1·174
30 "	1·45	1·77	1·602	70 "	·76	·76	·764
35 "	1·64	1·80	1·714	75 "	·53	·32	·436
40 "	2·11	1·71	1·926				

absolute deaths are only three to four times as great between 15 and 20 years as between 10 and 15, whence we conclude that phthisis not only appears from the table of absolute mortalities as a disease of developed life; but from this table of relative mortalities its tendency to attack the fully grown is made twice as manifest.

But to speak more strictly, it is especially a disease of the reproductive period of life.

If we turn again to the table showing the absolute deaths from consumption among women, we observe that they increase rapidly from 10 to 15 years, but very rapidly indeed from 15 to 20 years, during which quinquennium they reach their maximum for all ages. From this point they gradually diminish regularly and slowly until the age of 45 is reached, when there is a sudden fall to one-half of what it was during the previous five years. For the next fifteen years the deaths vary very little, and then suddenly decrease to insignificance. That is to say, phthisis becomes eminently fatal immediately on the accession of puberty among females, so as to reach its maximum at once, remains very prevalent, though gradually

Age in years.	A	B	C	D	E	F
1	2,762	8·26	2,340	3·	5,102	3·3
2	533	11·25	498	8·	1,031	10·
3	212	14·0	194	0·	406	7·
4	141	0·	141	7·	272	4·
5	230	22·	191	21·	421	21·
10	312	19·	301	13·	603	16·
15	198	35·	192	130·	390	88·
20	213	183·	236	275·	449	232·
25	265	185·	254	232·	519	208·
30	286	212·	231	242·	467	228·
35	287	185·	246	203·	533	192·
40	297	195·	242	149·	539	174·
45	302	119·	216	143·	518	129·
50	293	106·	171	76·	464	116·
55	317	95·	161	81·	478	90·
60	316	66·	185	65·	501	66·
65	281	60·	176	11·	457	42·
70	214	28·	175	23·	389	23·
75	206	5·	154	6·	360	5·
80	120	..	111	..	228	..
85	61	..	52	..	113	..
90	23	..	18	..	41	..
95	10	..	12	..	22	..

A. Deaths from all diseases among males in South Australia during 1874-77.
C. " " " " females " " "
E. " " " " both sexes " " "
B. Ratio per 1,000 of deaths from phthisis to deaths from all diseases among males.
D. " " " " " " " females.
F. " " " " " " " both sexes.

less so during the continuance of the reproductive period, and as soon as the grand climacteric is passed suddenly falls to a comparatively low figure and one that remains very uniform through many years. This greater liability during the child-bearing age becomes even more evident when we group the cases. Thus, during the first 15 years of life 52 died, during the reproductive period from 15 to 45, 346; and during the next 30 years, 52. So that nearly three and a half times as many females died during the reproductive period of 30 years, as during all the rest of life put together. The reproductive age is fairly definitely limited both at its beginning and its ending in women; whereas in men the bounds are not nearly so defined. Therefore, if phthisis is specially connected with the reproductive period, we ought to find that the deaths from phthisis are in the same manner, and in the same degree more sharply confined among women to a certain age than among men. We observe now that among the males 45 die up to the 15th year, 342 between 15 and 45 years, and 130 after the 45th year, or 342 from 15 to 45, and 175 during all the rest of life; a ratio of 1·96 to 1; but among women the ratio is 3·3 to 1. Therefore, phthisis is more limited among women than among men to this age to the extent of 75 per cent. And it will be noticed, further—and this gives additional support to the theory—that the difference between the ratios does not arise during the first fifteen years of life, but is rather lessened. So it ought to be, inasmuch as reproductive powers are not commonly possessed by either sex below that age; but females are more likely to possess them, more often possess them, than males. On the other hand, we perceive that the difference between the ratios does arise during the years after 45, owing to a greater number of deaths among the men than among the women; whereas among women, in whom this power so suddenly ceases, the fall is sudden after 45 years. Among men it does not suddenly fall, but continues much more gradually to decline down to 60 or 70 years of age, until which period this function is known still to persist. So that from the table of absolute deaths we may say that phthisis is very markedly a disease of the reproductive period of life. Moreover, we must modify somewhat our first proposition, viz., that it is especially a disease of maturity, inasmuch as the reproductive function rather than maturity seems to govern the fatality. We may much more accurately affirm that the reproductive function is that which especially rules our statistics of consumption. When this begins to be possessed, then phthisis begins to be much more prevalent. Since it is established earlier among women, consumption occurs at an earlier age among them; since it is suddenly lost by females, consumption

suddenly becomes less common amongst them; since it is retained by men down to the extremes of life, consumption loses little, if any, of its virulence among elderly males.

To ask the question whether this is special to phthisis, or common to disease in general seems absurd, for we find that during four years 3,857 females died from all diseases below the age of 15, 1,425 from this period up to 45 years, and 1,215 beyond this age; or 1,425 during the reproductive period, and 5,072 at all other ages, a ratio of 1 to 3½ instead of 3½ to 1.

But we may still inquire whether the table giving the percentage of deaths to the population confirms the proposition deduced from the table of absolute deaths. Without entering into all the particulars, we may say that it is confirmed in every point. The deathrate among the females per thousand of living population from 10 to 15 is ·41, from 15 to 20 it is 1·27, more than three times as great. This is the sudden rise on the accession of puberty in the female. From 40 to 45 it is 1·87; from 45 to 50 it is ·84, a considerable fall at the cessation of the reproductive function. The rate from 15 to 45 is 7·7, for all other ages only 1·4, or 4·5 times as great. The rate from 45 to 75 is 4·2, or only a little more than half that of the reproductive period. Among the males the rate from 10 to 15 years is ·16, only a slight increase over that of ·09 from 5 to 10, when compared with that among females, viz., from ·079 to ·41, explained by the existence puberty among girls under 15 much more frequently t among boys. From 15 to 20 years it is ·77, a great adv over the rate of ·16 from 10 to 15, concurrent with the se in of puberty among the great majority of males. From 45 years it is 6·9, at all other ages 2·9, or only 2·4 to 1, of 4·5 to 1 among the females, corresponding with the of any limitation of procreation among men. From the rate is 8·5 per thousand, an increase over that f 45, and very different from the 4·2 per thousand females, which is a decrease from that of 15 to them, and presenting very boldly the different phthisis among men and women after 45 years, erence in regard to the reproductive function is

To test this theory, if possible, still further w males as almost certainly in possession of t function from the age of 20 down to the There were in the year 1876 53,044 men of th them there were 427 deaths from consump may almost as certainly regard as procreat 45, of which age there were 44,971 perso deaths in the five years. Here, then, we of such ages, that both are under the a

and so far as we can judge about equally. How do the ratios compare?—427 is to 362 as 53,044 is to 44,965, which 44,965 is so close an approximation to 44,971 as to be quite remarkable. So that it is evident that when men and women are of the reproductive age, and therefore are both under the influence of this predisposing cause, they are both to an exactly equal degree liable to consumption. Beyond the age of 45 there were 15,327 men with 130 deaths, and 12,876 women with 51 deaths; but with this number of females there ought to be 105 deaths, if the rate were the same in the two sexes. So that among the women after 45 it is only one-half what it is among men. Since after 45 the mortality among women is but little more than one-half that before 45, it might be laid down as a rule in female insurance that a consumptive history should only be estimated at one-half the importance after 45 that it holds prior to this age. It would seem, then, that so long as women are subject to this predisposing cause they are as liable to consumption as men, but that directly this influence is withdrawn they are only half as liable. This to my mind appears almost like a demonstration of the theory that the reproductive function is a great predisposing cause of phthisis. Would it be presumption to assert that this cause accounts for one-half of the phthisis mortality. If we compare phthisis among the two sexes—up to 20 among males, and up to 15 among females—it would seem at first glance as though the deathrates should be equal, because above we have reckoned from these ages. On examination, however, we find them not equal. There are 56,824 males and 47,780 females; 90 deaths among the former and 52 among the latter. But to be in the same proportion the female deaths should be 76; therefore it would seem that even when the influence above indicated is absent from both sexes the deaths from phthisis are among males half as much again as among females. This would seem to oppose the theory. But the opposition is only seeming, for although in our former calculation we started from the ages of 20 and 15, this was not because all below those ages are free from the influence, but because practically all above those ages are subject to it, for without doubt many are possessed of this function at earlier years, and it is quite certain that this is the case to a much greater extent among males below 20 than among females below 15. Hence it is not proper to compare the sexes below those ages respectively. We should expect the rate to be higher among the males. That it is higher rather supports than opposes the theory.

On the other hand, it will be as useless and improper to contrast the sexes, both up to 15 years, because it is fairly certain that the function is far more likely to exist among

females than males, and so the deathrate would rule higher among them. Hence we find that there are 45,733 boys with 45 deaths, and 47,780 girls with 52 deaths; so that the mortality is greater among the girls. And if we limit the examination to the sexes under 10 we have to deal with such an insignificant number of cases and so large a number of children comparatively that any result would decide nothing at all.

In this influence of the reproductive function we find, I believe, an answer to the question, Why is it that males are more liable to the affection than females? Why do 16 men die to every 15 women? Because phthisis is ruled by reproductivity, and this is more persistent among men than among women, and so acts upon them for a much longer period.

If this theory be correct it opens up a very wide field for speculation as to whether it may not be through this channel that many supposed causes act. Is it true, as is popularly supposed, that phthisical females are more prolific than others? If it be, may we not read the fact reversely, that prolific women—women in whom the reproductive power is very strong—are more liable to phthisis? The influence of city life, sedentary employments, indolence, on the one hand; a country life, open air exercise, and muscular pursuits, &c., on the other, may exert their predisposing or antagonising influences through this medium. But we will cease even to suggest, lest we should appear to be riding the theory too far.

Such, then, seems to be some of the information to be derived from our colonial statistics respecting this generally interesting disease; of so general interest because there are few if any families that have not been invaded by it. None the less interesting, both to the faculty and the laity, in that the information derived is not altogether in accord with popular notions upon the subject. There are some points for congratulation. Our deathrate is not one half of that in the old country, and probably the disease does not attack us so early, nor run so rapid a course. We may remember, too, while we "groan and sweat under our weary life" in summer, that there is at least one class of patients to whom this season comes with comfort and prolongation of days. But we ought to remember especially—and this is cause for solicitude rather than congratulation—that the mortality is increasing, and it behoves us in the interests of medical science—and none the less in the interest of our fellows—to find out the reason why: whether because the beneficial influences of our climate are becoming more widely known, and attracting more sufferers, who, as a forlorn hope, come to our colony to die, or whether because of deleterious circumstances, which we are creating

and fostering, but which we ought to be lessening or stamping out. The first step to this end seems to be to ascertain the duration of residence in the colony of every victim of this disease. This could easily be effected by the medical men, and being entered henceforward on the certificate in the allotted space, would allow for a return for the last half-year of 1879, and by the end of 1880 we should have data for a fairly correct determination of the question raised.

THE INSECTS OF SOUTH AUSTRALIA AN ATTEMPT AT A CENSUS.

By OTTO TEPPER, Corresponding Member.

Scientific knowledge concerning the Entomology of South Australia appears to be in a considerably less satisfactory state than in the other Australian provinces, to judge by the researches of the President of this Society contained in the Anniversary Address, and published in the "Transactions, &c., of 1878." There is little or no scope to doubt that the facts are as stated. Whatever the causes may be, there is certainly a wide field open for individual and collective effort ere the province will compare favorably in this respect with its neighbours. They have splendid handbooks of their living and extinct fauna and flora, well illustrated, and published at a price within reach of all; splendid public collections of specimens properly arranged and named; and information can be obtained on any subject at a nominal fee—all through governmental foresight. With us little of the kind is found, and (sad experience compels me to say it) the most zealous amateur, if not possessed of great connections and ample means, soon ceases in his efforts, when he finds it next to impossible to obtain the true name of any but the commonest natural object; for, without a name there is no real knowledge. How does he know when he discovers anything *new?* To aid progress he must be able to advance by study to the very confines of what is already known; and this he can only accomplish by means of proper public institutions, else he wastes his energies upon work done over and over by others. The following short review of South Australian insects contained in my private collection is intended only as a small contribution towards elucidating the subject.

The enumeration of the genera and species is interspersed with remarks about the habits, &c., of the most remarkable ones, in order to make the subject less monotonous.

For more than twenty years some of my scanty leisure hours have been devoted, among other kindred pursuits, to the observation and collection of insects in various localities within the southern portion of this province, the outer limits being Mount

Bryan in the north and Mount Gambier in the south. Through various causes the earlier collections were lost to me, but not the experience gained. The present collection to be reviewed in the sequel dates in its beginning about twelve years back, was brought together within a very limited area, and comprises, in round numbers, about 2,600 species (while in the anniversary address cited above the author only enumerates 782 species as scientifically known to exist in *all* South Australia!), gathered within a radius of a few miles around New Mecklenburg, Lyndoch, Tanunda, Nuriootpa (N.), Callington, Monarto (E.), and Ardrossan, Y.P. (W.) Having always kept specimens from other parts of Australia, &c., *strictly* separate, the numbers given can be confidently taken as referring to really indigenous insects. The three principal centres from which my excursions radiated were—(1) New Mecklenburg, four miles W. of Tanunda, and includes Lyndoch; (2) Nuriootpa, four miles N. of Tanunda; (3) Monarto, eight miles east of Callington, including the neighbourhood of the latter and the scrub to the Murray River, and comprising by far the largest area.

These three specialised areas, furnishing quite 95 per cent. of the insects to be mentioned, overlapped each other very little; the remaining five per cent. were got by occasional short visits to other localities, and friendly exchanges in slight proportion. At the first place named 587 species were obtained in four years; at the second, 785 additional in nearly five years; and at ths last, 948 additional, in eighteen months. But it is not to be understood that so many species are strictly peculiar to each locality, but only that they were there obtained first. The following table shows in a condensed form some details of the distribution of the respective orders, but one—the Aptera—has not had attention paid to it:—

TABLE OF THE NUMBERS OF FAMILIES, GENERA, AND SPECIES OF SOUTH AUSTRALIAN INSECTS.

Orders.	Number of Families.	Number of Genera.	Number of Species.
1. Coleoptera	18	198	1,411
2. Lepidoptera	19	80	395
3. Hymenoptera	14	84	240
4. Orthoptera	7	16	134
5. Hemiptera	12	28	272
6. Neuroptera	9	16	43
7. Diptera	8	17	159
8. Thysanura	1	1	1
Total	88	390	2,655

Order Coleoptera.

The Coleoptera, or beetles, form the most numerous order of Insecta, 80,000 species being mentioned by Dr. Leunis (Naturgeschichte, 1868) as known to exist, and are represented in my collection by more than 1,400 species, constituting 53 per cent. of the whole, yet by no means comprising nearly all the species known to exist in the localities indicated. In the arrangement Latreille's system has been principally followed on account of its simplicity.

Commencing with the Cicindelæ: their rarity is very remarkable, only five species in two or three genera having been obtained. One species of the typical *Cicindela* occurs near Lake Alexandrina, white and dark-grey in colour, where it is fairly numerous at times. Another, very rare and minute, was taken at New Mecklenburg, near the banks of the Gawler. A brilliant golden green *Tetracha, said* to have been taken near Port Wakefield, occurs in the Far North, and also near the Australian Bight, as I have been informed. A small, dark-coloured species, glittering as if bedewed by jewels, related to *Tetracha*, was taken near Nuriootpa and at Ardrossan.

The Carabidæ are more numerous than the foregoing, mustering 123 species in about 28 or 30 genera. Some of the latter are fairly rich in species; thus *Bembidium* is represented by ten, *Carabini* (all small) by fourteen, *Chlænius* by eight, *Scaritidæ* by thirteen (the largest about one and a quarter inch

Table showing Number of Genera and Species of the Families and Groups of Coleoptera.

Families and Groups.	Number of Genera.	Number of Species.
1. Cicindelæ	2 — 3	5
2. Carabidæ	28 — 30	123
3. Natatores	5 — 4	21
4. Staphilini	6	26
5. Mordellæ	6 — 3	21
6. Elateridæ	9 — 7	42
7. Buprestidæ	10	143
8. Rhipiceræ	1	2
9. Clerici	28 — 10	37
10. Lamellicornia	13 — 29	144
11. Clavicornia (Imhoff)	14	89
12. Baculicornia	15 — 2	6
13. Heteromera	4 — 16	113
14. Meloidæ	7 — 5	27
15. Chrysomelidæ	8	123
16. Ciclicæ	2	82
17. Rhynchophora	20	289
18. Longicornia	25 — 26	11-
Total	186 — 196	

in length, viz., *Scaraphites crenaticollis*—Mount Gambier, Bremer, Glenelg; and *Sc. donastes*—New Mecklenburg, Ardrossan), *Calixia* by fifteen, *Philophlaus* by twelve, *Adelotobus* by six, *Sylphomorpha* by five, *Pterostichus* by four species. Other genera again exhibit but one or two representatives, as *Catadromus* (*C. australis*, the largest beetle of the family, attains the size of one and three-quarter inches at Blanchetown, River Murray; while those captured at Lyndoch and Blumberg are much smaller, and may be, though coloured similarly, a distinct species). Other genera, similarly poor in species, are *Calosoma* (two), *Platysoma*, *Hellus*, and *Brachinus* (each one). The last is the curious Bombardier Beetle, emitting a small puff of blue smoke several times in succession, with a perceptible noise when approached by the hand. They were taken near Lyndoch and Nuriootpa. In February last I met for the first time, and in a single instance, with a species of *Eudema* at Ardrossan, resembling a species from Queensland. Some other genera, names unknown to me, make up the total given above.

Of NATATORES, the Water Beetles, twenty-one species (not including the largest of all, the gigantic *Hydrophilus* of Lake Alexandrina) have been obtained, forming at least four genera, viz., *Dytiscus*, four; *Gyrinus*, two; *Hydrophilus*, seven; and *Hydrocanthara*, eight species. The giant of the family measures about two inches; the smallest scarcely exceeds one-twelfth of an inch in length.

The STAPHYLINI, those curious beetles with shortened elytra, are, except two or three species, generally very rare, showing a total of twenty-six species in five or six genera.

Proceeding to the SERRICORNIA, those Coleoptera which exhibit more or less serrated or saw-like antennæ, we find them in plenty. They will be enumerated under five heads.

The MORDELLIDÆ, a family of small-sized beetles, living upon the sweet juices of flowers, and whose last pair of legs is fitted for leaping, furnish us with twenty-one species in two or three genera. Some of the species are exceedingly numerous in their season, every flowering Eucalypt or Melaleuca hiding numbers of them.

The ELATERIDÆ are much more numerous in species than the preceding, supplying a contingent of forty-two in, probably, six or seven genera. All, with exception of one or two, are of sombre uniform colour, ranging from light brown to jet black. One species, not enumerated (because not in the collection), is known by me to occur in the Barossa Ranges. It is of small size, but great beauty, the thorax of a bright red and the elytra of metallic steel blue colour. The largest *Elater*, inhabiting the Gawler scrub, is about one and three-quarter inches long and three-eighths of an inch wide; the next in

size, less in length but the same width, was obtained near Callington; and a third, about one inch, at Ardrossan. All three of a dull black hue. In one instance only a single *Eucnemis* was taken (near Nuriootpa), a genus distinct from *Elater*, by the absence of the power to project itself forcibly upwards, when placed upon the back, and the more cylindrical shape of the body.

The BUPRESTIDÆ which are the pets of most entomologists, on account of their varied brilliant coloration, are represented by 143 species in at least ten genera, and form one of the most numerous families. The genus most prolific in species is *Stigmodera* with 71. Among the *Buprestids* are some of the largest South Australian Coleoptera, viz., two *Stigmodera* and one *Sternocera*, species attaining or approaching the respectable length of two inches and a width of three-quarters of an inch. Two species are peculiar to the pines *(Frenela robusta)*, three or four to *Casuarina stricta* (sheoak), a large number to the Acacias *(A. pycnantha* and others), and one or two—viz., *Cyria imperialis* and another, live upon *Banksia marginata* (honeysuckle), but by far the largest number have their wants of life supplied by the flowers, &c., of *Eucalyptus*, *Leptospermum*, *Melaleuca*, and *Callistemon*. The larvæ of most live (for years it seems) in the living wood and bark of the trees, apparently eating their way downward, as the beetle generally makes its appearance through an opening near the roots. Some larvæ live in the adhering, dead, corky bark of *Eucalyptus rostrata* and other trees, and the beetles of these are in many instances distinguished by metallic colours. Only one or two live upon grasses, and are very minute.

RHIPICERA is only represented by two species, of which one hails from Mount Gambier and the other was obtained at Monarto. The latter is possibly only a variety.

The CLERICI show a tolerable variety of forms, presenting 35 species in about ten genera. *Natalis*, including the largest in size, and *Trichodes* are the most conspicuous. They are widely different in their habits, some being carnivorous, others licking the nectar of flowers. The larvæ of some live under the bark of trees; that of one species inhabits a large spongy fungus growing parasitically on the branches of large Eucalypts, and another finds the *ne plus ultra* of existence in putrid carcases of animals, which the perfect beetle also frequents.

The LAMELLICORNIA, or Coleoptera with leaf-like extremities to their antennæ, are well represented by at least 29 genera with 144 species. The most numerous family is *Melolontha*, comprising, with its near allies, 69 species, some of which attain a considerable size (exceeding one inch), but most are small. All

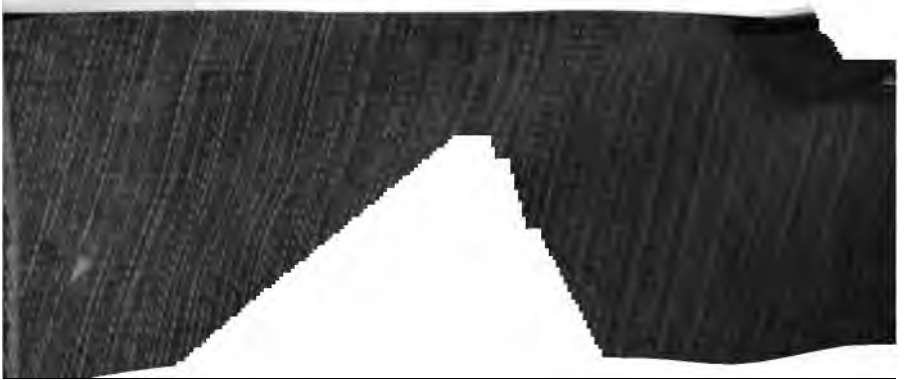
are destructive to vegetation—one species, pre-eminently so at times, I described in a paper published in the "Transactions of the Adelaide Philosophical Society, 1878," and named it provisionally "*Melolontha destructor*." Some smaller species are occasionally as destructive in proportion to their size upon small bushes, but are seldom noticed The *Rutelidæ* are represented by two genera—*Anoplognathus* (one species) and *Repsimus* (three species, perhaps only local varieties). All are large beetles, and the individuals of the former frequently swarm in hundreds during warm evenings in spring, buzzing among the leafy tops of *Eucalyptus rostrata* and *E. viminalis*. Their browsing in zigzag lines betrays them unerringly to the observer, as no other South Australian beetle seems to indulge in this singular habit. *Scarabæus*, and four or five allied genera, furnish 19 species, most of medium size, some attaining one inch in length. *Gryphodes* musters 7 species; *Trichius* 1; *Copris*, *Geotrupes*, and the rare *Bolboceras* 19 collectively. The commonest of the *Copridæ*, also the largest, infests the droppings of cattle, &c., in numbers, and drills deep circular holes in the hardest soil underneath for the accommodation of its eggs and larvæ, for which purpose it is fitted with a large horn upon the head and four on the prothorax. Its colour is a dark, glossy chestnut. The family of the beautifully-formed *Cetonias* contains three genera, of which *Schizorrhina* is the most numerous, containing 8 species, the other two being represented by one each only. The largest of the *Schizorrhina*, said to be from Mount Remarkable, measures one and a half inches. The smallest *Cetonia* of another genus exceed half inch scarcely, and was noticed at Callington, but is numerous at Ardrossan. One of the *Schizorrhinas*, jet black, with green spots upon the upper and bright yellow markings on its legs and abdomen, lives upon *Eucalyptus viminalis*, the larvæ inhabiting the decaying inner portion of the same trees, and when entering into the chrysalis state form oval, cocoon-like cases for themselves by glueing together their own hard, roundish excrements and grains of soil. *Passalus* seems unrepresented in our neighbourhood, but Mount Gambier furnishes one large species, similar, if not identical, to a Victorian ally, and one and a half inches long. *Figulus* contains five closely allied species, all of which (and larvæ as well as imago) inhabit dead decaying wood. Of the magnificently-coloured *Lamprimus* two species are represented. Both are similarly coloured—the males of a brilliant metallic golden hue, the females of a lustrous golden green; but in the one species, which feeds upon the large native marshmallows, the male exceeds the female much in size, while in the other, feeding

upon gum-leaves, this is not the case, or only slightly. Besides these, I obtained once some specimens of a species (in the Barossa Ranges) having the prothorax very conspicuously marked with indentations. Another species observed at Mount Gambier is distinguished externally by both sexes being of the same colour—a golden leek-green—and nearly of the same size. The *Trogidæ* are not very numerous, showing about three genera with nine species, the majority living in putrid matter, one in very moist manure.

The CLAVICORNIA, or club-horned beetles, are rich in forms, but fortunately less so in individuals, for most are extremely destructive to animal substances, comprising about 13 or 14 genera and 89 species. *Histeridæ* are catalogued with 18, *Hololepa* with 2, *Nitidula* with 3, *Sylphæ (Hemaphila)* with 1 species. The last is of large size, above an inch; but, frequenting putrid carcases, manure heaps, &c., upon which it and its larvæ feed, possesses, though looking pretty, a perfectly horrid odour. *Conetelus* and its allies number 17; *Coccinella* 2 species. The *Dermestidæ (Anthrenus*, &c., incl.) are at least in one species very numerous in individuals; 21 species are in the collection, and another was observed in a solitary spot near Lyndoch, within the charred hollow of a large *Eucalyptus rostrata*; it is jet black and covered with numerous white dots; length one quarter of an inch, width less than one-twelfth inch. *Paussidæ* are very rare; three species were captured. *Cephalotes* (?) are numerous in individuals; 11 species (some doubtful) have been obtained. The *Ptinidæ* and *Anobii* are also mentioned here on account of their similarity of habit, and are not very promiscuous in number. *Gibbium* appears in six and one or two other genera in seven species.

The BACULICORNIA (Dr. Imhoff) appear to form about the smallest group of beetles, *Collydium* comprising four, and *Brentus* one, perhaps two species. The latter I found rather numerous on ferns at Mount Gambier (which covers there extensive parts of the country), but much less so at other places, and generally under lose bark.

The HETEROMERA present a great variety of forms in about fifteen or sixteen genera, with 113 species, among which *Tenebrio* numbers six, *Tentyria* two, *Akis* six, *Blaps* four, *Opatrum* eight species; these latter are found generally under loosely-adhering bark, where they and their larvæ feed upon decaying substances, and are all of a dusky hue, but while alive are covered with fine white dust, easily removed by a touch, lending them a purplish tinge. *Saragus* adds eight, *Helops* five (one of these, one inch in length, jet black, while in the larval state, mines through and feeds upon the decayed outer portion of very old dry gum-trees), *Adelium* eighteen



species. Some of the last could once be taken in scores at certain spots in the Barossa Ranges, where a few years later very few could be found. They possess in common with the two following genera a curious weapon of defence in one or two hand-like processes, which they protrude from their anal extremity, moistened with some adhesive fluid of disagreeable odour. *Titæna* comprises ten species, some of which are among the first beetles appearing in spring. The majority of the ten species of *Amarygmus* are endowed with most beautiful iridiscent colours when alive, owing to the extremely fine crenulation of their upper parts. The largest and most beautiful species lives upon mallee *(Eucalyptus dumosa)* and is three-quarters of an inch in length; the smallest scarcely a quarter of an inch. There is only one species of *Lagria* found in the neighbourhood of the large common fern, and one *Bictomis* under the bark. Of *Helæus* and its near allies there are seven species indigenous (three more besides were taken at Ardrossan), *H. princeps*, Hope, the largest and commonest, occurring at New Mecklenburg, Monarto, and Ardrossan. *Lyctus* (with perhaps one or two other genera included) with seven, and *Bostrichus* with two or three species, conclude the list.

The family of the MELOIDÆ is sparingly represented. Of the genus *Meloe* I only know one species, living upon a small shrub in the hills about Williamstown and the South Para, but is not in the collection. The *Lyttae* in three or four allied genera muster twenty-seven species in all. In former years some species were fairly numerous, but of late I find them all rare, or even very rare. Some are arrayed in brilliant colours, in one the male entirely different from the female.

The CHRYSOMELIDÆ are rich in species, but all small, none exceeding one quarter of an inch. Their seven or eight genera contain a total of 123 species. *Chryptocephalus* comprises twenty-six, *Haltica* nine, *Eumolpus* fourteen, *Podontia*, with its near relations, thirty-two, *Chlamys* twenty-one, and the *Cassidæ* twenty-six species.

The CICLICÆ are very numerous, are partly plant-feeders, partly carnivorous; some fly by day, others by night. The genus *Paropsis* is the most numerous, furnishing with an ally seventy-six species, some of which, while alive, exhibit brilliant red, green, and blue colours, fading into a dull uniform yellow a few hours after death; other species change their delicate neutral tints into a bright brick red, within a few days. Among the fifteen species of *Polyglypha* is one nearly approaching in colouration the notorious Colorado Beetle, but it is rather rare and seemingly harmless. Another species is clothed in resplendent golden green, iridising in all colours of the rainbow. It is small in size, but found at times in considerable numbers upon certain

shrubs from Mount Bryan to Callington, from the Murray to Ardrossan.

The RHYNCHOPHORA, or weevil-like Coleoptera, are the most numerous family here as elsewhere, furnishing at least 20 genera, with 289 species. The *Bruchidæ* and their relatives number 22 species, some over an inch in length and some under a quarter of an inch; some of very strange appearance, caused by curious excrescences upon prothorax and elytra; all are wingless, mostly living on or under the ground; their elytra are firmly joined in one piece of armour. The *Curculionidæ* present 21, the *Anthonomidæ* 30 species, some of which are active all the year. *Rhynchaena*, with *Gonipterus*, count 29 species, one of the latter in almost endless variety; *Apoderus* 20, *Anthribus* 15, the *Apionidæ* with over 20, *Cossonus* 8, the largest infecting *Eucalyptus rostrata*, *Rhinomacer* 5, all rare; *Eurhynchus* 3, *Hypphorynus* 4, including the giant, and also the most beautiful (the black and golden green Diamond Weevil) of the whole family; *Balanius*, with its kindred, 38; *Rhinotia* 15, and *Belus* 26 species. Both the latter genera are peculiar to Australia. *Lixus* occurs in one species, said to have been obtained near Angaston.

The LONGICORNIA, the long-horned or Wood Beetles, are well represented by 118 species in about 26 genera, but many are very rare. The first in array are the *Prionidæ*, with five well-defined species; the larvæ of the largest feeds within the trunks of the *Casuarinæ*, the beetle attaining the length of nearly three inches; another species peculiar to *Eucalyptus viminalis* and *rostrata*, measures 2¼ inches. The large oval holes seen in timber are due to their larvæ, the circular ones being drilled by the larvæ of moths. Both kinds of larvæ are eaten by the natives. The *Cerambidæ* (*Mallodon*, *Epithora*, &c.) number 18 species, the largest exceeding 1¼ inch in length. *Pyrocantha* contains 18 species, the commonest, *P. recurva*, is found sometimes swarming in hundreds after sunset around felled gumtrees, or broken branches, in the bark of which their eggs are deposited, the larvæ, when hatched feed first upon the bark and afterwards enter the splint This species extends to the Northern Territory. *Molorc* contains one species, noticed at Lyndoch and Monarto. *Clytus* (or a closely allied form) there are three specie *Phacodes*, *Callidypsis*, and another one each; *Chlythanth* *Leptura* two each; *Stenodema* numbers ten; *Stenopte* *Hesthesis* three species. Both the latter genera h elytra very much reduced in length, simulating appearance. One species of *Hesthesis* seems ide *H. plorata*, from Tasmania, the other is much t species of *Eurisepa*, one resembling *Ctenodes*.

the larvæ of one of which appear to feed upon the roots of tufted grasses, and the appearance of which signalizes the approaching end of the insect season, and another with soft elytra, feeding on Eucalypts (both with two species) add a total of six to the number.

The *Saperdæ* are numerous, *Lamida* exhibiting fourteen; *Symphyletes* twelve; *Hebescesis*, seven; *Distema*, two species.

Besides the above, a *Mallodon* specimen was in one instance taken by me near Lyndoch, just having made its escape from its larval abode in a large *Eucalyptus rostrata*, resembling (if not identical) in colour and size a species from the Northern Territory, one and a half inches in length. A species of *Distichoceras*, resembling *D. maculicollis*, from New South Wales, was once captured by me near Williamstown, by the Victoria Creek, but not seen since.

The largest of the South Australian *Lamidæ* noticed by me was taken by a friend near Callington; it exceeds one and a quarter inches in length.

After a somewhat hasty comparison of the beetles captured at Ardrossan with those collected elsewhere, it is found that altogether 266 species of Coleopters were taken, of which 106 are common to other places, while 158, or 62 per cent. of the whole number, were obtained here for the first time. Two of these Coleopters deserve a short notice. The one is allied to the Prionidæ, and seems to form a link between them and the Buprestidæ, for the form of its body closely resembles theirs; while the antennæ, mandibles, &c., denote their other connection. Their colour is a bright-brown, and their length nearly one inch. The other remarkable beetle belongs to the Dorcadiæ, and to a genus not before represented in the collection, and closely resembles some species of Bruchidæ, indigenous here, were it not for its antennæ, &c. Both species seem very rare. The first was taken in January, the other in February last.

The generic names given above have been taken partly from the following works, viz., Dr. Imhoff's "Studium der Coleopteren," 1856; Brockhaus' "Text zum Bilder Atlas," 1857; Dr. Leunis' "Naturgeschichte," 1869; Dr. Ruete's "Zoologie," 1843. Some names were obtained through exchanges with other collectors, notably to Messrs. J. French, Melbourne, and E. D. Atkinson, Tasmania, my thanks are due. Only a very few names were got from the South Australian Museum.

Order Lepidoptera.

The Lepidoptera of South Australia are characterised by almost total absence of gay and brilliant hues, especially among the nocturnal tribes; the overwhelming majority only

presents inconspicuous neutral tints. The cause of this may be sought for chiefly in the great dryness of the atmosphere, and the obvious protection it affords in seasons of drought in concealing them from birds and other enemies in eager pursuit of anything capable of serving as food.

The PAPILIONIDÆ, or butterflies, furnish 26 species in twelve genera, according to the determinations of the Hon. W. MacLeay, Sydney, of a series of figures drawn by me and submitted to him by the President, to both of which gentlemen my thanks and acknowledgment are due. There is one *Papilio* (*P. Erythonius*), the largest of the family, and measuring three and three-quarter inches in span. It inhabits the open glades in the Barossa Ranges. The *Pieridæ* are represented by *Pieris Aganippe*, Don., and *P. Teutonia*, Fabr., flying in the neighbourhood of Lyndoch, Nuriootpa, Monarto, and Ardrossan. *Terias smilax*, Don., sometimes is numerous near Lyndoch, and occurs at Ardrossan. Of *Nymphalidæ*, the genera *Pyrameis*, with two species, viz., *P. cardui*, Linn., and *P. itea*, Fabr., and *Junonisa* occur; the latter only represented by *J. velleda*, Linn. The first and last are very common, and fly nearly all the year; *P. itea* is rare. The *Satyridæ* likewise

TABLE SHOWING FAMILIES AND NUMBER OF GENERA and SPECIES OF LEPIDOPTERA.

Families.	No. of Genera.	No. of Species.
1. Papilionidæ	12	26
2. Crepuscularia	5 or 6	10
3. Noctua-Lithosidæ	1	3
4. Arctiidæ	4	4
5. Liparidæ	3	8
6. Cossidæ	2	9
7. Cochliopodæ	2	4
8. Hepialidæ	1	4
9. Psychidæ	2	12
10. Saturnidæ	3	3
11. Bombicidæ	2	10
12. Notodontidæ	1	4
13. Cymatophoridæ	1	4
14. Noctuidæ	13	52
15. Chlœophoridæ	2	4
16. Agaristidæ	2	4
17. Geometræ	10	78
18. Tortricidæ	2- 3	39
19. Tineæ, Pyralis, Alucita	9-10	117
Total	77-80	395

furnish two genera, but with only one species each, viz., *Xenico Klugii*, Gner., which is common almost everywhere; and *Heteronympha Merope*, one of the largest and finest of our butterflies, but rather rare. It has been captured at Lyndoch, and seen at Ardrossan. The occurrence of *Danais Chrysippus* is very curious, it being at home also in the Grecian Isles and on the Mediterranean shores, according to Dr. Berge. My specimen was caught in Nuriootpa. Of *Lycænidæ* several genera are represented, viz., *Lycæna discifor*, Fabr.; *Cupido bretica*, McLeay, *C. agricola*, and six others; the largest of which measures one and a half inches, and the smallest only three-quarters of an inch in span. The largest of the family is *Ogyris otanes*, Feld., occuring in the sandhills near Nuriootpa, which is the only locality I have noticed it. The female has a short, broad cross band of light yellow upon the anterior wings, of which the male is deficient. The *Hesperidæ* furnish one genus, viz., *Hesperilla*, with two species, both probably new, and rare at the best of times. Of the *Uranidæ* we have four species of one genus, viz., *Synemon læta*, MacLeay, *S. scaria*, Feld., and two others, probably unnamed. The genus is the only one, it appears, peculiar to Australia, and is not referred to in G. Master's "Catalogue of Diur. Lepid., 1873;" but it is placed here among the butterflies, because the antennæ terminate with a true club, and they often carry their wings upright like all true day-flyers, while the other genera included in the group do not do so.

The CREPUSCULARIA, or dawn moths, are still more conspicuous by paucity of representatives than the foregoing, and mostly very rare. Of *Sphinx* there are only two species known to me, both of medium size, viz., two and a quarter inches in span; one *Macroglossa* bred from a chrysalis found at Nuriootpa, a species resembling *Thyria;* one *Zygæna* from Monarto, and five of *Sesia*, or near allies; thus only showing ten species in five or six genera.

The NOCTUADÆ, or moths proper, furnish the great bulk of species, there being no less than 125 *Nocturnæ*, 78 *Geometræ*, 39 *Tortricidæ*, 106 *Tineidæ*, six *Pyralidæ*, and five *Alucitæ*, and their allies. The work of reference chiefly followed is almost exclusively Berge's "Schmetterlings Buch," but the four last tribes are not treated, and therefore only mentioned collectively in the sequel. Of the 24 families of nocturnal Lepidopters therein described several seem to be entirely absent, notably the *Syntomidæ*, *Heterogynidæ*, &c., and others are only sparingly represented.

Of LITHOSIA three species occur. The ARCTIIDÆ are represented by the genera *Deiopeia*, *Emydia*, *Euprepia*, and *Spilosoma*.

The LIPARIDÆ furnish three genera and eight species, viz., *Leucoma*, three; *Ocneria*, one (obtained from chrysalides at Ardrossan); *Porthesia*, four.

The COSSIDÆ supply the largest moths in the Province, one species of *Cossus*, Fabr., exceeds seven inches in span, and two or three others approach it in size. The larvæ of these inhabit the trunks and main branches of divers Eucalypts, drilling circular holes about three-quarters of an inch in diameter through the sound timber. Eight species are in the collection.

Of the allied *Zeuzera*, Latr., one specimen was taken at Ardrossan.

The family of the COCLIOPODÆ, of which the caterpillar forms hard, egg-shaped cases for the chrysalis, the latter developing its limbs in distinct and separated casings, the genus *Limatodes*, Latr., exhibits one, and *Promecoderis* three species. The HEPIALIDÆ furnish four species in one genus. PSYCHIDÆ are numerous; the genus *Psyche*, Schr., containing five, and *Oreopsyche*, Sp., seven species. The caterpillars of this family form for themselves a dwelling, consisting of a silky bag overlaid with little sticks, &c., in which also the chyrsalis state is passed. Woods mentions the largest of these bag-bearers under the generic name *Oiketicus*, I believe. The SATURNIDÆ seem scarce, only three species having been found, representing as many genera, viz., *Endromis*, Ochs.; *Saturnia*, Schr.; and *Attacus*. The latter exceeds three inches in span. Its caterpillar is of a green colour, and feeds on the leaves of *Eucalyptus viminalis*, forming an oval cocoon of dark-grey silk one inch in length.

Gástropacha is represented by seven species, two of which form the bright green silky cocoons found suspended among the leafy tops of Eucalypts. *Eriogaster*, Germ., contains three. Of the NOTODONTIDÆ four species occur, seemingly of the genus *Cnetocampa*, Steph., the caterpillars of which live and feed in great societies, marching out in procession. They pass the chrysalis state either under loose bark or in large nest-like structures among the smaller branches—(a social spider mimics them)—of the trees on which they feed. Great damage is sometimes done by them.

CYMATOPHORA, Tr., furnishes four species, and forms the connecting link between the foregoing and the *Noctuadæ* proper. The latter are rich in species, but often scarcely separable. Among them the following appear, viz.—*Panthea*, Hübn, (*Bombix*, Latr.), with four; *Bryophila*, with one species; *Leucania* contains seven, mostly numerous; *Tryphaena*, Hübn, three (all rare); *Agrotis*, Ochs., fifteen; *Episema*, Ochs., ten species; all of the last genus are very active moths, flying in the glaring daylight of spring and summer.

Mamestra, Tr., adds five, and *Rhizogramma*, Led., two species; the chrysalis of the latter is enclosed in a cocoon case formed of grains of soil glued together. *Xylina*, Tr., is represented by two, and the allied form of *Calocampa*, Steph., by one species; all rare. The *Plusiidæ* furnish two species to the collection, but a third is known to exist. The caterpillars of one sometimes attack the potato-plant seriously, feeding at night only, and burying themselves in the loose soil during the day. *Catocala*, Schr., one of our finest moths, and numerous in individuals at times, seems to occur only in one species, while *Halias*, Tr., and *Chlœophora*, Steph., both green coloured moths, and resembling *Geometræ*, present two each. There are three species of *Agarista*, Walk., and one of another allied genus. They are fine black and white coloured moths, flying high and swift during the afternoons of the summer months.

The GEOMETRÆ offer great variety in their numerous forms, but with the exception of *Nemoria*, with one rare species coloured green, and one species of *Himeria*, habited in pink and yellow, are of the prevalent sombre hue as the rest. *Zerene*, *Amphydasis*, and *Crocallis*, contain each one species; *Aspilates*, nine; *Gnophos* and *Fidonia*, each nineteen; *Acidalia*, eighteen; and *Numeria*, six species.

The TORTRICIDÆ are represented by about 39 species, but are far outnumbered by the TINEIDÆ, of which *Lithocolletis* alone, with, perhaps, some near allies, musters 34, all very small, and many distinguished by black and orange colour. Two species of *Tinea* are known to cause and inhabit as larvæ some curious galls in eucalyptus bushes, within each of which several of them dwell at the same time. One or two species are distinguished by a small number of hemispherical protuberances upon their upper wings, near their insertion, arranged in a half-circle when at rest, and glittering like veritable jewels. Besides *Lithocolletis* there are three or four other genera containing 72 species, giving a total of 106 *Tineidæ*. Of PYRALIDÆ there are six, and of *Alucita* and kindred genera there are five indigenous species. Many more of these tiny *Lepidopters* are known to exist, but have been neglected in the collection, their small size and extreme delicacy offering considerable difficulty in respect of preservation. Yet, small as they are, they are capable of inflicting serious loss at times. One example will suffice. Annually a large quantity of potatoes are destroyed by premature putridity, caused by a host of larvæ of some small *Tinea* forming tortuous canals within the tubers.

Order Hymenoptera.

Of Hymenoptera, or yoke-winged insects, the province of South Australia possesses a fair share (and, indeed, of at least one family—*i.e.*, ants—rather more than fair), as far as numbers are concerned. According to Dr. Leunis 15,000 species were known in 1868, being at the ratio of three Hymenopters to four Lepidopters, compared with the foregoing order; but as the collection only contains 240 species, giving a ratio of three Hymenopters to five Lepidopters, it proves that this order had not had the same attention paid as the preceding. This is indeed the case, the fact having to be admitted that the ants, Cynipsidæ, and indeed all the small wasps, were greatly but unavoidably neglected for want of leisure and facilities. The remarks made when treating of the Coleopters, in respect of the names mentioned apply to this order likewise.

Of the Tenthredidæ, or saw wasps, the genera *Cimbex* and another are represented by eleven species, the largest of which, golden green with yellow markings, is about an inch in length, the smallest about a quarter of an inch. They chiefly infect eucalypti. The Cynipsidæ, or gall wasps, are very numerous, to judge by the number and variety of galls met with upon many plants, sometimes of exceedingly fantastic shapes; only four species, the largest seen, were collected. Of the Ichneumonidæ, some seasons exhibit quite a crowd; they deposit their eggs in other living insects while in the larval state, and offer one of the most effectual checks to undue increase of any one

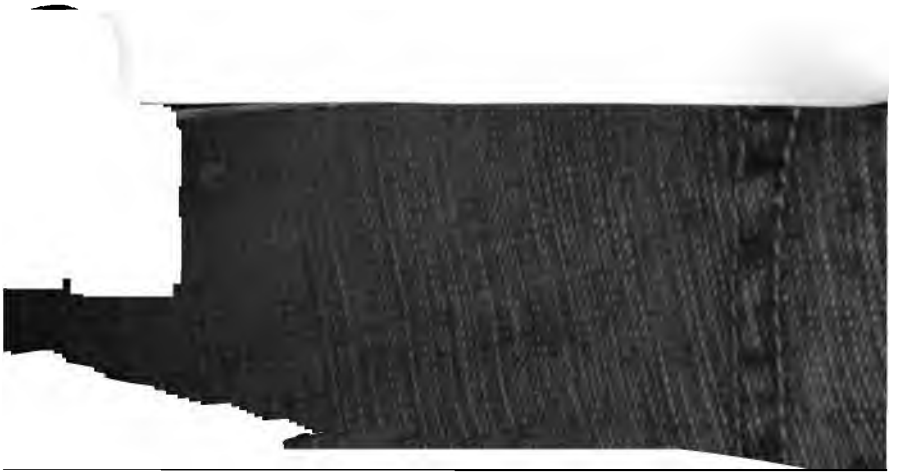
Table Showing Families and Number of Genera and Species of Hymenoptera.

Families.	No. of Genera.	No. of Species.
1. Tenthrididæ	1—2	11
2. Cynipsidæ	1	4
3. Ichneumonidæ	8	24
4. Ophionidæ	1—2	21
5. Pteromalidæ	1—2	4
6. Chrysidæ	1—2	9
7. Formicidæ	2	29
8. Mutillidæ	2	44
9. Myrmiloidæ	1	11
10. Sphegidæ	4—5	28
11. Crabronidæ	6	31
12. Vespidæ	1—2	8
13. Polistidæ	1	1
14. Apidæ	8	15
Total	28—34	240

species in the economy of nature. Some species of the genus *Rhyssa*, represented by six species, are very common, others scarce. Of *Ephialtes*, with two or three near relations, there are seventeen species; some of these are provided with very short ovipositors, others with very long ones; thus the largest of the genus is scarcely half an inch in length, but its ovipositor exceeds an inch and a half. This one is very rare. Of *Pimpla* only one species is known, nearly the same size as the preceding. The OPHIONIDÆ, or sickle wasps, are numerous in most species, of which there are 21, principally appertaining to *Anomala*. The largest exceeds one inch; the smallest is under half an inch.

The PTEROMALIDÆ furnish four, and the CHRYSIDÆ, with some allied genera, nine species, one of which is endowed with strong legs for leaping.

The ants are present in immense numbers, mostly of small size, every inch of the ground in "the bush," except where wet, being haunted by them during the chief part of the year. Some species defy the fiercest heat of the summer; others never appear in daylight. Only a small proportion has been collected yet of *Formica*, distinguished among other peculiarities by comparatively weak mandibles and small sting, the latter frequently quite absent. Sixteen species of the larger kinds have been collected, and of *Myrmica*, with powerful mandibles, terrible sting, and ferocious temper, as many as thirteen. The largest of the winged females of *Formica* is about three quarters of an inch long, but the neuters are always much smaller. They inhabit burrows in the ground with a solitary shaft; hide during daylight, and hunt about by night. The smallest species is less than one-sixteenth of an inch, of a pale ochreous colour, and never appears voluntarily above the ground in daylight. It is often found in farm-houses with natural floors, to the intense annoyance of housewives, the liliputian armies invading sugar, jellies, &c., and tenaciously refuse to quit these substances alive. Among the *Myrmicidæ* are some of the most formidable of their kind, nearly one inch in length, boldly attacking any casual invader of the precincts of their nests, singly and in force, and inflicting a most painful wound with their long stings, scarcely less in effect as that of a scorpion. The popular name "bulldog ants" is a very appropriate designation. Of these there are three distinct species. The allied "jumping ants" have much shorter legs, are, with the exception of one species, much smaller, and can leap several inches. They live in burrows drilled by them in dead branches, and are black; but others, of a clear brown colour with a yellow spot on each side of the abdomen, live exclusively in galleries of still living wood. Another small species with golden green



head and thorax dwells under stones and dead timber. It represents the "fire ant" of South America, and, like the others, inflicts very painful stings. The MUTILLIDÆ are numerous. The wingless females of the genus *Mutilla*, represented by fifteen species, resemble the *Formicidæ* greatly. Another genus, a description of which I have not met with, and therefore shall designate provisionally under the name *Myrmiloidæ*, closely mimics the *Myrmicidæ* in form of body, wings, and activity of movements, but differs in having a much smaller head, and the antennæ thread-like and unbroken. They fly about the lights at night, and can sting well. Eleven species have been collected. The genus *Thynnus*, peculiar to Australia, is represented by 29 species, which are very interesting. In Dr. Duncan's "Transformations of Insects," 3rd Ed., p. 217, it is said:—"Verreaux states . . . The male flies about, and "carries the female with him, paying her the greatest attention, and *placing her in flowers*, so that she can obtain her "nourishment. Frequently other males, which have not the "happiness of possessing a wingless companion, come near and "appear enchanted with her company. Of course *they all "become jealous, and should her protector be unable to conquer the "others, in order to disappoint them he eats her up.*"* This being so exquisite a piece of insect romancing *à la Buffon*, it is hardly necessary to state that I have never observed anything of the kind. What has been observed is simply this: The wingless female is so different in appearance from the male that hardly any amount of experience would enable a naturalist, seeing her for the first time, to recognise her as such, being nearly half the dimensions of the male, and gifted with only very short legs. As soon as hatched she climbs to the top of a high stalk of grass, &c., turns her head downwards and her abdomen away from her support in a sharp angle (say 40 to 50 degrees), thus awaiting the pleasure of some male. The latter flitting close by, whisks her up without any stopping, and carries her about while following his usual avocations. The female clings to his waist or legs until copulation is completed, when she drops off and seeks among the grasses, &c., where to deposit her eggs.

The SPHEGIDÆ were much more numerous, it appears to me, than of late. Then some stray or bold individuals often invaded the interior of cottages for the purpose of building their nests of mud on some rafter or in the corner of a window; now the appearance of one is almost an event of note, except near permanent watercourses. There are four species of *Scolia*, three being large insects; and one of *Ammophila*, which digs holes into the soil with great assiduity, stocking each with

* The italics are mine.—O.T.

a caterpillar heavier than itself. *Pelopæus* musters four species. The smallest lives apparently parasitically in the chrysalis case of a *Promecoderis*, instead of building a nest. *Pompilus*, with one or two allied genera, contains nineteen species, and includes the giants of the order. Of the CRABRIONIDÆ five or six genera occur. *Crabro* and *Cerceris* contain each three species; *Philanthus*, nine; *Odynerus*, four; *Eumenes*, with an ally, seven; and another genus, resembling *Odynerus*, five. The last differs from its next in kin, by having the third abdominal segment so large that the whole of the remainder of the abdomen can be withdrawn within it, telescope-fashion. Almost all of these exhibit one or other interesting trait of character. To mention one will suffice for the present. So-called "bunged eyes" are of common occurrence during the summer months, but their cause seems still undetected. Now it is well known that at that season certain *Muscidæ* infest the eyes of man and animals very annoyingly. A small *Odynerus* resembling these somewhat in coloration, hunts them and frequently takes them boldly from the human person, dashing boldly among them upon the hand, in the face, or even the eye, wherever they happen to be assembled, attacks one with his sting, grips it with the last pair of legs and flies off with it in less time than it takes to tell. People feeling this unceremonious onslaught, naturally or habitually put up their hand to catch or kill the intruder. If they happen to succeed in arresting it, it is at their cost, for feeling itself held, the *Odynerus* inflicts a sting in return and flies off, for its great hardness saves it from harm. The pain at first is scarcely perceptible, but grows—*creeps*, would be a better expression—rapidly more intense, causing a swelling of the affected part, in which it resembles the sting of certain Myrmicides. So far personal experience goes, but having been curiously free from induced swelling of the kind (even the sting of a bee near the eye left but a very slight trace after the abatement of the first pain), I have never suffered by this malady, and cannot testify to the effect upon others not so circumstanced, yet have frequently seen the *Odynerus* at work near the very eyes of people subject to the complaint. Another point is, that the little insect is especially busy in the early morning of very hot days. Without wishing it understood as attributing to it *in toto* this malady, yet I suspect it strongly as one of the causes. Further, I found that the application of ammonia in the earlier stages removed the pain in a few minutes in several cases, which would prove to some extent that it was due to *some* animal virus, if I mistake not.

The VESPIDÆ number about eight species in one or two genera, some being pretty large insects, but none as fierce as

the European species. Of the POLISTIDÆ, or paper wasps, there is one species, which builds its nest under overhanging rock on the River Murray cliffs, where they are pretty numerou

The APIDÆ or bees are not numerous. There is one large or resembling *Xylocapa* of steel blue or golden-green hue, form cells in small hollow branches of trees, not in the collect three species resembling *Osmia* (one having a prob equalling, if not exceeding its whole body in length), and e akin to *Megachyle;* total fifteen. Small swarms of the varying in number of individuals from a score or two to hundred, have been frequently observed on the standir crops towards evening, many laden with pollen. This c the account of our Hymenoptera. Fifteen spe obtained at Ardrossan, Yorke's Peninsula, the remai localities indicated before.

ORDER ORTHOPTERA.

The ORTHOPTERA of South Australia are not i in number of species, size, or interest; the coll 134 species. Most of these insects are veget species of the *Gryllidæ* committed considerabl and gardens a few years ago. The LAPIDU muster twelve species in the sole genus *Fo* their large transparent posterior wings coriaceous anterior ones, resembling the S Coleoptera; among our indigenous spec have a small coriaceous patch upon the f fectly colourless, exactly fitting on th the latter, thus affording additional delicate membrane. The BLATTIDÆ, o rich in species, exhibiting twenty-three but this introduced pest is fortunatel

TABLE SHOWING FAMILIES WITH NUMBE ORTHOPTE

Families.	
1. Lepidurida	.. .. .
2. Blattidæ ..	.. ..
3. Achetidæ ..	.. ..
4. Locustidæ	.. ..
5. Mantidæ ..	.. ..
6. Hydromantis	.. ..
7. Phasmidæ	.. ..
Total	.. .

larger ports and towns. Among the native *Blattæ* is one an inch and a half in length, but rarely found in the perfect winged state. Besides this there are several others, never attaining to the winged state. Several species hunt their prey by daylight, living upon bushes, and are exceedingly swift in their motions; all others prefer darkness. The ACHETIDÆ, or crickets, furnish nineteen species. The largest in the collection is about one inch, the smallest less than one-quarter of an inch in length. Most of them live in fissures of the ground, under stones, &c., but several species, distinguished by much reduced posterior wings (sometimes altogether wanting), live upon trees and shrubs, enlivening the surroundings with their exceedingly penetrating chirp. Of tree crickets, gifted with excessively long and thin antennæ and large wings, some very large ones are found, viz., above two inches in span, and the antennæ three to four inches long. They inhabit small hollows, lined with a kind of coarse silk, and appear to be carnivorous. Of *Gryllotalpa*, or mole crickets, only two closely allied species occur in watercourses and in moist situations.

The LOCUSTIDÆ are represented by at least six genera. *Locusta* contains sixteens species, most of which are rare, or even very rare. The body of the largest measures one and a half inches in length, the wings nearly four inches in span. Another, smaller in body, attains five and a quarter inches in span, and inhabits the Murray Flats, near Blanchetown. One species feeds upon the native pine *(Frenela)*, and is distinguished by its yellowish-green anterior wings being marked with numerous black dots; another with white spotted wings frequents *Melaleuca acuminata*, near Ardrossan; another, with pink-coloured wings, and a flat shield-like appendage to the thorax, feeds on mallee, near Monarto. But the strangest of all is a species living upon some Leptospermum shrubs. Its first pair of wings is narrow and of a greyish colour; but the second is large, and beautifully marked with concentric dark bands. These are *rolled* closely together, and form then an angle with the cylindrical abdomen. When resting head downwards (its usual position), it so closely resembles in form and colouration a twig of the shrub, that it is almost impossible to discern it, especially as its long thin legs and antennæ are laid close along the branch and perfect immutability is sustained by the insect. *Decticus* has been found in one species only near Callington. Its posterior wings are of a beautiful pink hue, while all else is green and white. Of *Tetrix* four species are known, fairly large insects, some with very large helmet-like expansions of the head. Of *Œdipoda* eleven species are noted, some of large size, feeding upon woody plants only. *Acridium* is represented by ten species, five of which are from

the neighbourhood of Ardrossan; the latter are small, but distinguished by beautiful red, pink, and black coloured posterior wings. *Gryllus* is prominent as the most prolific genus, containing twenty species, one of which (perhaps two) rendered itself notorious by its extensive devastations in 1871-2. Residing at Monarto at the time, I observed an army of these insects several acres in extent. Counting repeatedly the number included in a square foot, it was found that twelve to thirteen in front by eight or nine deep represented a fair average. At this rate the number occupying an acre exceeded four and a half millions! At the same time scores of such armies were met with in the more open parts of the colony, but very few in the mallee scrub. A wingless species of this genus is of very grotesque appearance, and the female about six times the bulk of the male. Another, but small species, has wings, by way of contrast, extending about twice the length of body when at rest.

The MANTIDÆ are represented by thirteen species in three or four genera. The genus *Mantis* contains five species, the largest of which is green and is nearly two and a-half inches in span; the smallest is grey and scarcely exceeds one inch. *Phyllium* furnishes two, both from Yorke's Peninsula; the largest measures two inches in length, two and five-eighth inches in span, with very small posterior wings, and is of green colour; the other is considerably smaller and of a brown hue, the anterior wings marked with a dark spot near the middle. *Cyphocrania* musters five species; the largest female is nearly four inches long and the span of the wings of the male exceeds this. The wings of the females are in some cases scarcely one third of the length of abdomen, and never exceeding one-half; those of the males, on the contrary, are very large and fitted for sustained flight. Their very long legs, upon which the extended narrow body gently sways to and fro, give a spider-like appearance, while their moveable head, with its large projecting eyes, and the devote attitude of the first pair of legs, resembling hands clasped in prayer, add something very human, not belied by their habits. They are the most perfect hunters and robbers, and know well how to hide or to surprise.

A very minute species of HYDROMANTIS lives in the North Para, but resembles the *Phasmidæ* somewhat in the form of its forelegs. It is only three-eighths of an inch in length, and very rare.

Among the PHASMIDÆ, of which three species have been collected, the largest of all South Australian insects occur. This species is five and one-eighth inches long; span of wings, seven and a quarter inches; length of first pair of legs, three and one-eighth inches. The whole of the body, the short anterior

(length one and five-eighth inches) and a narrow parchment-like strip of the posterior wings are green, except where the latter are covered by the former, where a fine pink line marks the upper surface of the one and the lower of the other. The covered portions of the large anterior wings are transparent and colourless.

Some 20 years ago this species was rather numerous near Lyndoch, but for many years few have been noticed. Two other smaller species were obtained at Ardrossan. The larger one is of the same form of body as the preceding and also coloured green, but the covered portions of the wings are bright yellow, and the nervures of the remaining parts of the posterior wings are of a rich rose colour crossed by numerous narrow, concentric bands of the same tint. The smaller *Phasma* has a thin elongated body (like a straw) three and five-eighth inches in length and of a reddish brown colour. The transparent posterior wings are tinted along the radiating nervures with many black spots, at almost regular intervals, leaving transparent concentric bands between them. Only one specimen of either was obtained.

Order Hemiptera.

The Hemiptera, forming two groups, viz., Heteroptera and Homoptera, are quite as well represented in South Australia as any of the other orders, the Heteroptera, or bugs, being represented by 164 and the Homoptera or Cicades by 108 species. The first family of the former, the Pentatomidæ, comprise the genera *Scutellaria* with three, and *Tetyra* with four species, which have their scutellum so enlarged that it covers the whole of the abdomen, and acts as a cover for their wings. These, as most other bugs, are plant-feeders, and some species are very

Table Showing Families with Number of Genera and Species of Hemiptera.

Families.	No. of Genera.	No. of Species.	Families.	No. of Genera.	No. of Species.
Heteroptera.			Homoptera.		
1. Pentatomidæ ..	5	81	1. Cicadæ ..	1	11
2. Reduviadæ ..	2	41	2. Fulgoridæ ..	7	93
3. Lygeidæ	2	16	3. Aphidæ ..	1	3
4. Pyrrhocoridæ ..	2	8	4. Coccidæ ..	1	1
5. Geocoridæ ..	2	8			
6. Nepidæ	2	2	Total	10	108
7. Hydrometridæ..	3	8			
Total	18	164	Total Hemoptera	28	272

numerous upon certain native shrubs. Some glitter in most brilliant colours. The genus *Cimex* furnishes the giant of the family, nearly one inch in length, feeding on *Eucalyptus dumosa*, twelve species. *Pentatoma* is most numerous, 52 having been collected. One or two species are notorious as infesting the vine, imparting their objectionable odour to the grapes. This odour is nearly the same for all the members of the group, excepting the *Hydrometridæ*. Another very minute species occasionally attacks the wheat crops to some extent, and has been figured and described by Dr. C. Muecke, M.A., some years ago. *Trichius*, represented by eight or nine species, has the thorax armed with spines; a very small one is furnished with a globular excrescence upon the prothorax.

The REDUVIADÆ comprise 37 species, mostly of very small size, and are carnivorous, hunting other insects. An allied genus, a description of which I have not met with, is remarkable on account of the singular form of its legs and antennæ. Both are thickly set with fine long hairs, forming in one or two species large brushes on the last pair of legs, which much exceed the others in length. They live under loose bark and in hollows and cracks of trees about Lyndoch, Nuriootpa, &c.; appear to be carnivorous, and are not very numerous. The LYGEIDÆ, or stinging bugs, are present in several genera, with sixteen species. They can and will inflict a most painful wound, when incautiously handled, by inserting their proboscis. The largest is about three-quarters of an inch in length, but (as most of this family) it is very rare. They hide by day under stones, leaves, &c,, and fly by night. One species is adorned and armed with spikes, and has a very attenuated form of body and limbs. All seem to be carnivorous. The *Pyrrhocoridæ*, eight species, are pretty large insects, vegetable feeders, and sometimes very numerous upon certain eucalypts and acacias. In them the distinctive odour is most prominent, being developed to such extent that the birds refuse them as food, and even the ants appear to avoid their approach. Of *Geocoris*, or underground bugs, eight species have been observed. They live in loose soils, and are not numerous. Of HYDROMETRIDÆ, or water bugs, four genera, with ten species, have been noticed. There is one large *Nepa*, or water scorpion, which frequents stagnant water, and is about one inch long; and one still larger, *Ranetra*. Both have long tail bristles, and sting with their proboscis.

Of *Notonecta* four species have been captured. They are found in the calm reaches of rivulets, and fly about at night. *Hydrometra* (*Gerris?*) and another genus (*Halobates?*), with two species each, complete the list of the *Heteroptera*.

The HOMOPTERA, or Cicades, are scarcely less numerous than

the preceding group; but several families, notably APHIDÆ and COCCIDÆ, have been unavoidably neglected as far as collecting is concerned.

The CICADÆ furnish eleven species, of which the largest known to me measures several inches in span, is prettily coloured in yellow and brown, and feeds upon *Casuarina* and *Acacia pygnantha*. The next in size is nearly black, feeds upon *Eucalyptus rostrata* and *E. viminalis*, and is common about Adelaide. A third very large species habited in green tints lives about Mount Gambier upon *Acacia obliqua*. A much smaller species is peculiar to the mallee, another with spotted wing to banksias, and a number of smaller ones to various grasses. They are the principal musicians of the Australian forests, but their strains are more loud than pleasant. The *Fulgoridæ* muster seven genera, with 93 species. The typical genus *Fulgora* furnishes only two species, both very rare. *Cercoptis*, only one, but numerous, the larvæ of which produce the so-called "cuckoo spittle." Two genera not mentioned in Reute's "Zoology" are in so far remarkable that the one presents the extreme of lateral, the other of vertical compression. Eight species have been observed, all of which are vegetarians, and their larvæ in many instances exude a sweet liquid, much in request among ants, which lick the same and never hurt either the larvæ or the adults. Several species of *Aphidæ* have been observed upon divers native plants, besides the introduced Rose Aphis. One species feeding among the roots of the wheat-plants attacked by a *Fusidium* (the so-called "take-all"), has been described and figured by Dr. C. Muecke, M.A.; and is in some seasons exceedingly numerous, flying at night towards the light, and adhering in great numbers to the lamps. Another much larger species was observed by me on the roots of some sickly young plants of *Eucalyptus globulus*; it is snow-white, and forms protuberances around the rootlets. A large and beautiful species of *Coccus* occurs in the scrub near Lyndoch and Nuriootpa, and also at Mount Gambier, where it was fairly numerous among the ferns. The female is from one-fourth to more than half an inch in length, exhibiting the usual characteristics of the family, and its body is filled with a bright red fluid. It attaches itself to a twig of *Santalum* or other shrub, inserts its proboscis, and never leaves its place again. The male is much less in size, but gifted with two large glassy wings twice the length of the body, and a tail formed of numerous snow-white silky hairs, giving to the insect when slowly flitting in nearly straight course through the shrubs the exact appearance of a tiny comet, suggesting as most suitable appellation the name of *Coccus cometarius*.

Order Neuroptera.

The Neuroptera are not conspicuous either for size or coloration, and most genera are also poor in species. Only forty-three species in fifteen or sixteen genera have been collected. Many are insatiable hunters, and therefore useful to man by checking the increase of flies and other insects. The Libellulidæ, or dragonflies, furnish twelve species in three genera, viz., *Æshna*, *Libellula*, and *Agrion*. Many more are known to exist. The Myrmeleonidæ, or ant-lions, exhibit thirteen species in three genera. *Myrmeleon* furnishes six species, the largest about three inches in span. The larvæ possess very large mandibles and hide at the botton of small, funnel-shaped hollow, in which ants, &c., are entrapped and devoured. *Ascalaphus*, distinguished by long antennæ with spoon-shaped extremities, is only represented by one species, but the golden-eyed *Hemerobius*, whose larvæ act the lion among aphides by night, musters six. *Raphidia* and *Panorpa* present only one species each; the latter is common almost everywhere in the bush, catching and devouring all day long whatever insects it can manage. *Phryganæa* and *Perla* comprise three species each, and *Ephemera* two. *Mantispa*—so named because closely resembling the Mantidæ in general form—supplies four species, linking the Neuroptera to the Orthoptera. *Semlis* and two other genera only add one species each. The *Termites* are likewise represented by one species only. They are small and found nearly everywhere, but not nearly so destructive than elsewhere. Where undisturbed they form low, conical hillocks, generally marking the site of a stump of some tree. The only native timber withstanding their attacks to any extent is the inner red wood of *Eucalyptus rostrata* and somewhat less *E. viminalis*. Being kept powerfully in check by the *Formicidæ*, their natural enemies, the white ants act rather beneficially by masticating and reducing into fertile humus all animal droppings and decaying vegetable remains.

Table Showing Families with Number of Genera and Species of Neuroptera.

Families.	No. of Genera.	No. of Species.
1. Termes	1	1
2. Ephemeridæ	1	2
3. Libellulidæ	3	12
4. Myrmeleonidæ	2	7
5. Hemerobini	1	6
6. Raphidiæ	2	5
7. Panorpini	1	1
8. Perlidæ	4	6
9. Phryganidæ	1	3
Total	16	43

Order Diptera.

Of Diptera, or flies, a fair number of genera or species occur, while in number of individuals some species are so prolific that probably only the ants vie with them. On account of their fragility of structure, &c., no great attention has been paid to their systematic collection, yet 158 species have been obtained in about seventeen genera. Some species of the Nemoceræ, or long-legged flies, are prominent by their number, thus the genus *Culex* furnishes thirteen species, termed commonly mosquitoes, of which some are only found near water, in which the larvæ live, and others in the driest portions of mallee scrub, suggesting a different course of metamorphosis. All are very bloodthirsty, and on two occasions I observed dense clouds of a very small species (not included in the above number) after sunset near Lakes Alexandrina and Albert, that it became difficult to breathe without inhaling some. *Tipula* furnishes nine species, the largest of which is gifted with legs nearly two inches long, and as brittle as glass threads; it inhabits the Barossa Ranges, and does not attack man. Of *Cecidomyia*, the gall-producing flies, several species exist. An ally, the so-called sandfly, is a very minute insect, scarcely one-twelfth of an inch long, yellowish-grey in colour, and its wings speckled, and is found in cloudlets in sandy parts of the country, flying in the latter part of the afternoon during the spring and summer months. They settle upon any part of a person, move to an exposed part of the skin, and insert their proboscis, thereby causing a pain wholly disproportionate to their size. Each incision produces a minute swelling—producing great annoyance only by their number. The sensation produced may be compared to that of mild scalding. The Asilidæ and their near allies comprise nineteen species,

Table Showing Families with Number of Genera and Species of Diptera.

Families.	No. of Genera.	No. of Species.
1. Nemocera	2	22
2. Asilidæ	3	36
3. Syrphidæ	4	37
4. Tabanidæ	3	25
5. Muscidæ	3	24
6. Volucellidæ	1	14
7. Cecidomyia	1	—
8. Leptatænidæ	1	1
Total	18	159

including the giants of the order, which inhabit York Peninsula and adjacent parts, and measure one and th quarter inches in length. All are carnivorous.

Æstrus musters eight species, but whether any of t really do attack horses, &c., in order to deposit their upon them, as the typical species, I have not been abl ascertain satisfactorily. *Vermileo* supplies nine species links this order to the Hymenoptera, resembling certain s of wasps much in outline, with their highly-coloured atten abdomen. *Syrphus* comprises twelve, *Stomaxis* seven, eight species; the latter all of very small size. *Chryso* nishes ten species, mostly remarkable for the brilliant of their eyes while alive, but fading soon after *Holophilus*, with three, and another genus with larg body and very small head, with two species, are ve The TABANIDÆ, on the contrary, with fifteen species, n enough to be unpleasant at times; some species attack beast fearlessly to suck their blood. The allied genus five species, is not ravenously inclined. The MUSCIP proper, are well represented by four or five gener species. *Gymnosoma*, comprising flies whose larvæ interior of other living insects, finally destroying are noted with three species, but many more exis this kind greatly assisted in reducing the locusts ago, two or three small flies having been observed t dead ones clinging to shrubs, &c. Of *Sarcophaga* have been collected, but only two seem to interfer comfort by depositing their young larvæ in meat food. Fourteen species of *Musca* have been obt actual number may be considerably larger. S including the introduced house-fly, are exceedin and increasing in exact proportion with dom notably of cattle and horses, whose droppings fo and food of the larvæ. A few pounds weight o contains several scores of larvæ of flies. Th attacking the eyes of man with most assiduous i the summer months appears to be a native; it the woods, and, as the season advances, invad tions in the country. *Volucella*, with fourteen the largest *Muscidæ*; some are embellish metallic hues and changeable tints; some a none interferes apparently with man. Of Lr several species are to be noted; they atta sitically to native animals. The largest native opossum, clinging to the inner side about a quarter of an inch long when gorge or four have been seen in one ear.

THE GEOLOGY OF THE HUNDRED OF MUNNO PARA.

PART I.—THE NEWER TERTIARY ROCKS.

By GAVIN SCOULAR, Corresponding Member.

PREFATORY REMARKS.

The Hundred of Munno Para, which has its southern boundary about fourteen miles north of the South Australian capital, comprises, in rough numbers, an area of about 120 square miles. It is bounded on the west by the Hundred of Port Adelaide; on the north by the Gawler River and Hundred of Nuriootpa; on the north-east by the South Para; on the east by Tenafeate and Little Garden Creeks; on the south-east by Gould's Creek; and on the south by the Little Para River.

In descending order, the geology of the entire hundred may be summed up as follows:—First, recent *Alluvium* and *Travertine;* secondly, the *Drift* or *Pliocene*, occupying, superficially, nearly three-fourths of the whole area; thirdly, *Upland Tertiaries*, generally believed to be of Miocene age; fourthly, the *Fundamental Rocks*. The *Miocene* and *Fundamental Rocks* will be dealt with on a future occasion.

SUPERFICIAL ACCUMULATIONS.

As in many parts over the earth's surface, the most recent geological deposits throughout the district are found on the *flats* of creeks and rivulets, and in other tracts within the district, where causation formerly, or now, exists favourable to collect water-borne material of alluvial character. Collectively the alluvial deposits of the district occupy an area only of a few hundred acres:

Wind an Agent of Transport.—Another prime agent of transport carrying on, at present, and through all time, over the *land surface*, a redeposition of the incoherent material we find spread over the surface of the country, which cannot be overlooked, more especially in such a climate as ours, is the action of winds. As proof of this assertion I might here refer the incredulous in this particular to an early inspection of the tiny *sand-drive* accumulated to the leeward of the small grass tussock, and those of more stately proportions bestuding the

surface of the country wherever a pre-existing cause intervenes sufficient to arrest the passage of the aerial-borne material. These combined with the decomposition and redistribution of decayed vegetable matter may be said to be the prime agents producing our soils.

Travertine.—Next in the series building up the geological structure of the district—or rather I am of opinion, with my friend Professor Tate, they should be included as contemporaneous with the above-named deposits—are those depositions peculiar to our country familiarly known throughout the Province by the term "Crust Limestone." Deposits of this so-called crust limestone occupy considerable tracts throughout the district. In many places it is rapidly forming incrustations a few inches below the surface, whilst in others I have seen it actually intercalated with the soil.

These recent calcareous accumulations must be regarded as aggregations of limy material derived from the debris of older tertiaries, and limestone beds of the older fundamental rocks, together with magnesia derived from the decomposition of clay-slate and other rocks of the old series, reduced to a state of solution by the action of rain and spring-water percolating through the soil and subsoil, and other strata ; then by evaporation the liquid passes off in vapour, and the precipitate forms an irregular incrustation over, or near, the surface. Concentric structures of nodules frequently enclose fragments of foreign matter, land shells, &c. By chemical analysis its composition has been determined to be a carbonate of lime and magnesia, therefore the more appropriate name by which it can be designated is that of "Dolomitic Travertine." To the curious in such matters I will here direct attention to a very fine section—the formation of which was still going on until arrested about 26 years ago by the erection of flour mills over the site—on Smith's Creek, Section 4,160, Hundred of Munno Para.

Drift.

Character and Extent.—Proceeding backward in time, the next formation which will occupy our attention differs essentially from the preceding in so far that it has long ceased actual formative activity ; I mean the *mottled clays* constituting the subsoils of our *plains*, which are for the greater part of a calcareo-argillaceous character.

The deposit extends over nearly three-fourths of the hundred, occupying uninterruptedly the whole of the western portion of the district, as far easterly as Section 2,021 on the Little Para, and Section 1,723, Gawler South. As might be supposed, it does not follow a direct alignment between the points named ; nevertheless, omitting for the present three

minor *outliers*, it attains very nearly the same altitude above sea level for the entire distance, presenting as it were a serrated outline along the western base of the Gawler hills. The three exceptions to this general rule, which have come under my notice, occur within the district, viz., in Smith's Creek, and two other minor gullies. These outliers are found resting far within the general profile of the western escarpment of the range, and have an elevation of about 550 feet above sea level; whilst the maximum height of the main field of these deposits is about 150 feet less.

Denudation since the Deposition of the Drift.—The existence of these detached masses demonstrates the vast extent of denudation that the Drift has been subjected to. In short, when we consider that these outliers formed once an integral part of the deposit of the neighbourhood, and also the difference of their level over that of the main sheet, we cannot help inferring that denudation since the era of the deposition of the *Drift* must have abraded from the western slopes of the Munno Para Hills material to the extent of at least 150 or 200 feet in vertical measurement.

Depth and Water Supply.—The mean depth of the formation, so far as I am aware, has not yet been ascertained. No shaft or bore has been put down in any part of the district, unless in search of water, the line of which, over that portion termed the lower plain, can be pretty accurately determined from the rise and fall of the surface. The water, though often not good, is obtained in many instances at the depth of a few feet from the surface, whilst in the neighbourhood of the Gawler Railway Station it is not reached at a less depth than from seventy to eighty feet (and in one well in the immediate vicinity the water is very salt). The water obtained from wells in Gawler South and West is generally of very good quality; at present, however, I cannot speak authoritatively of the character of the potable water bearing stratum, but that of the saline one is immediately under a bed of highly water-worn pebbles, from the size of a man's head to that of a pigeon's egg, conglomerated imperfectly together by an incoherent arenaceo-argillaceous paste.

Though the water-line, throughout the lower reaches of the plain, can be pretty much depended upon, yet no such regularity prevails in the upper. As an instance of such irregularity I may mention that the water-line immediately around the Smithfield Railway Station does not exceed fourteen feet; whereas at the Inn, about 600 yards distant, it is upwards of seventy feet, the difference of surface level being less than twenty-five feet, and of the water-line of the wells more than thirty feet. Besides the difference in level their is a difference

in the properties of their water, as per analyses supplied me by Mr. A. Thomas, F.C.S. :—

	I. At Railway Station.	II. At Inn.
Sulphates..	0·62	0·48
Chlorides..	5·60	11·20
Total grains per gallon ..	6·22	11·68

This difference leads me to infer that the supply is derived from totally separate local sources; I say local, because in neither case can the supply be derived from the general source or reservoir from which the wells of the lower plain are supplied, the water level of which is, at least, forty feet lower in the series than either.

As we approach the hills a very different phenomenon is presented. In no instance—unless from winter soakage at the outlets from the hills of a few gullies—have any previous attempts to procure water by sinking into the so-called drifts been successful. About twenty or twenty-one years ago the Hon. Thomas Hogarth put down two shafts in Section 4,151; also about the same time the late Mr. Alexander Cullan put one down in Section 3,205 (reference to map of the district will show that Mr. Hogarth's and Mr. Cullan's trial shafts were distant, as the crow flies, from each other about four and a quarter miles), and in each case—twice by the former and once by the latter—were the variegated clays of the formation pierced at a depth of about eighty feet. In subter-position to this eighty feet of calcareo-argillaceous material was found a semi-consolidated white-yellow siliceous sandstone, and though I am not prepared to state to what depth it was penetrated in the late Mr. Cullan's shaft (not less than twenty-five to thirty feet), yet the Hon. T. Hogarth informs me that in one instance on his estate at Smithfield it was perforated to a depth of forty feet without any visible sign of change. No *well*, in the true sense of the term, can be obtained in this exceedingly permeable stratum until a more impervious material is reached; which in all likelihood will not be at less depth than 170 feet. But because the nearer we approach the hills the more saline the character of the water becomes, I venture to predict that the water obtainable from this source will be nearly as salt as the sea itself. However, the effect of this buried sandbank is to produce a comparatively waterless subterranean tract skirting the base of the Munno Para Hills.

The Origin of the Drift.—Let us now briefly inquire into the nature of the agency to which these beds owe their deposition. It has been advanced by our esteemed friend Professor Tate, of the Adelaide University, that our South Australian *Drifts* owe their deposition to ice action. And why not? But before the mind can be persuaded to accept that theory it must be pre-

pared to admit that when glaciers slid from the summits of the Gawler Hills to be borne away in the shape of icebergs upon the waters of some nameless inland lake, upon the floor of which the earthy burden of these supposed ice-streams were deposited, the contour and profile of the surrounding country must have been very different from that we at present see. To obtain glaciation of the Gawler Hills, one or other of the following natural conditions must have prevailed:—(1) A change of the present position of the poles of the earth; (2) or that our sphere was passing through a more frigid region in space than now; (3) or that the heat-producing properties of the sun for the time being became greatly diminished; (4) or that the Gawler and neighbouring hills had an elevation sufficient to retain the aqueous vapours reaching their summits in a state of congelation; (5) or a shifting northerly of the belt of trade winds. In short, one or other of such must have been the ruling state of nature before any part of the Australian continent could be wrapt in a mantle of ice. My present object is to deal only with the subject locally, and so far as the evidence that Munno Para supplies the problem is left in a state somewhat as follows:—It is true that no remains of marine life have as yet been discovered in these beds, and though it is regarded almost as a recognised maxim by the geologist and paleontologist that deposits from which no fossil remains have been exhumed are not of marine origin, yet I am of opinion that whilst many of that class of scientists advance that theory as very good negative evidence, few, I presume, would for every case be prepared to uphold such as a positive occurrence. Though this seeming unfossiliferous state of things so far as known really does prevail throughout the Munno Para *Drifts*, yet we must bear in mind that necessary conditions are required to ensure preservation after death, in a somewhat similar degree as to sustain existence during life; and that shore-lines, more especially those of a bold character, must in my opinion be still less adapted for the preservation and retention within their sediments of animal forms, either in a fragmentary or entire state, than those of a less abrupt outline. If we reflect for a moment on the small tithe of living forms that have been preserved and handed down to us in a fossil state, even in beds most prolific in fossil forms, we should wonder less when we find them to contain no animal remains; and we are apt to conjecture such beds were laid down under such and such conditions, unwittingly overlooking the important fact that their non-fossiliferous appearance is not because animal remains are not present there, but because they are not there in a palpable state.

But to return from the suppositionary to a more tangible

line of argument. The Munno Para *Drifts*, though regarded non-fossiliferous, and consequently with great probability were of fresh water origin, yet they present features which should lead one to a somewhat modified decision. The waters with which these *Drifts* are surcharged in five cases out of six are found to be impregnated less or more with saline matter, some of them to an extent altogether rendering them inappropriate to animal use. Such being the case, an impartial juryman would naturally conclude had the beds in question been of glacial—which amounts to the same as their being of fresh-water origin—being aware also that the waters with which by far the greatest extent of these beds is at present, and has been for thousands of years past, surcharged, must necessarily be rain-water, that they should not now so frequently produce waters of a saline character. Secondly—Pieces of charred timber, analagous to that still growing in the adjacent hills, have on several occasions been found by me imbedded in these deposits at a depth of twelve feet from the present surface, proving, pretty conclusively to my mind at least, that glaciers did not occupy the summits of the Gawler hills at the period of their growth, as none of the present species of the *gum tribe* could have withstood the severe cold which necessarily must then have prevailed. No *striated pavements*, either, or transported boulders, presenting the least sign of ice-action, have as yet been discovered throughout the entire area of the *drift* of Munno Para or neighbouring hills, though real water-worn pebbles are found to occupy a position nearly in every section where the base of the formation is exposed, as it thins out against the western slope of the hills.

Such is a brief outline of the evidence Munno Para supplies as to the glacial, or fresh-water origin of our South Australian *drift* deposits. Whilst the drifts of Munno Para yield nothing that could warrant the assumption that the *drift* formations of the colony were the outcome of a cold and pluvial period; yet we have, nevertheless, slight evidences of ice action presented in a few places throughout the Province such as the *striated pavement* at "Hallett's Cove," and the *transported boulders* associated therewith. But the scanty evidence that these mere outliers of information render, ought for the present to be accepted with great caution. The phenomena of striation of rock surfaces and boulders of foreign character have often been found to have arisen apart from the direct outcome of glaciation; and, therefore, I am for the present inclined to regard them as such; and although the conditions under which our drift deposits are laid down be still, at least to me, an inscrutable enigma, nevertheless I will venture to put forth a theory, which, though not new to science,

is, so far as I am aware, new in application to this case, whereby it is not only probable, but very possible, that our comparatively recent *drifts*, which occupy considerable tracts of the lower situated lands of South Australia were laid down.

The great philosopher, Laplace, was the first to demonstrate the fluctuation of sea level. In short, he was the first to advance that the level of the ocean was regulated entirely by transference—on a grand scale—of solid matter from one part of the earth's surface to another. The same theory was revived about ten or twelve years ago by Dr. Croll, of the Geological Survey of Scotland, and subsequently accepted by Sir William Thomson, F.R.S. It would be presuming too much, on my part, to enter here in detail upon matters with which a majority of members present are fully acquainted. Allow me, however, to state this much that Dr. Croll and Sir William have penetrated into the mystery so far as to enable them to advance the opinion that our earth undergoes long secular changes of summer and winter, brought round by some natural law, just as truly and surely as that regulating the change of our annual summers and winters.

Treating on this subject, Dr. Croll expresses himself in the following words:—"When the eccentricity of the earth's orbit is at a high value, and the northern winter solstice is in perihelion, agencies are brought into operation which make the south-east trade winds stronger than the north-east, and compel them to blow over upon the northern hemisphere, as far probably as the Tropic of Cancer. The result is that all the great equatorial currents of the ocean are impelled into the northern hemisphere, which thus, in consequence of the immense accumulation of warm water, has its temperature raised, and snow and ice to a great extent must then disappear from the Arctic regions. When the precession of the equinoxes brings round the winter solstice to aphelion, the condition of things on the two hemispheres is reversed and the north-east trades then blow over upon the southern hemisphere carrying the great equatorial currents along with them. The warm water being thus wholly withdrawn from the northern hemisphere, its temperature sinks enormously, and snow and ice begin to accumulate in temperate regions. The amount of precipitation in the form of snow in temperate regions is at the same time enormously increased by the excess of the evaporation in low latitudes resulting from the nearness of the sun in perihelion during summer."—(Geological Magazine, Decade II., vol. v., p. 397.)

Dr. Croll sums up his argument as follows:—"The final result to which we are, therefore, led is that those warm and

cold periods, which have alternately prevailed during past ages, are simply the great secular summers and winters of our globe, depending as truly as the annual ones do upon planetary motion, and, like them, also fulfilling some important end in the economy of nature."

From the foregoing quotations, it will be observed that the effect of such changes, while the south-east trade winds are attaining their maximum value, by their continued urging forward of the warm waters of the tropics into the northern hemisphere, is to raise the temperature of these regions; consequently the accumulated snow and ice of ages in that hemisphere will disappear. Though not quite so at present, I imagine if reckoned by a lengthened period of time, the heat derived from the sun must be pretty equally divided over both hemispheres. Nevertheless, when it becomes diverted—as in the manner pointed out by Dr. Croll—by an indirect agent, as it were, from the southern into the northern hemisphere, though the cold in the former may be setting in almost imperceptibly, it must necessarily be diminishing, in a corresponding ratio, in the southern. Briefly, sufficiently so, if prolonged for a lengthened period, to produce a glacial epoch —down at least to the 45th degree of latitude—over the southern hemisphere.

Let us now inquire a little more in detail what effect such a state of things would produce. "We have no reason," remarks Dr. Croll, referring to the glacial epoch of the northern hemisphere, "to believe that the total quantity of ice was much greater in the globe than at present, only it would then be all on our hemisphere." Few, I think, will venture to gainsay the philosophy in that statement; and, as I have already stated, the sun's heat, if considered by lengthened periods of time, will be distributed equally over both hemispheres. Whilst the north is sustaining a frigid condition, the south must necessarily be receiving more than its fair equivalent of sun's heat; to restore, therefore, uniformity or equal distribution, the south must pass through a frigid condition also. If we at all can be guided by the opinion of such minds as Archdeacon Pratt, the Rev. O. Fisher, and the author just quoted, then were the ice now accumulated over the northern hemisphere transported into the southern, it would have the effect of displacing the earth's centre of gravity sufficiently to submerge the southern shores of Australia to the extent of something like 600 feet. It was whilst the southern hemisphere was passing through one of these protracted winters that we must look to as the age of *Drifts*. Not that I believe they were laid down through the direct agency of ice—for we have no evidence, unless in cases where altitude can be shown to have acted as

the ice producer, that the general ice-sheet has descended in either hemisphere far below the 45th degree of latitude—and we have no data to warrant the supposition that Australia has passed through any elevatory ordeal since long anterior to the era of the Drift. Nevertheless, apart altogether from elevation having anything to do in the matter, whilst the cold period was approaching to and receding from its maximum value, for countless ages probably a continual frigidity prevailed over the southern hemisphere at no greater distance from our southern shores than ten degrees. Australia then must have witnessed a very different climate than she now enjoys. Though we have no reason to infer other lands in the southern hemisphere then existed than do at present—and these, according to Dr. Croll's theory, would then attain a proportionate lower altitude above sea level as their situation approached the south pole—yet it might be reasonably inferred that sufficient dry land did then exist to produce icebergs of enormous proportions. Existing lands are the South of New Zealand, Sibrina Land (situated about 1,600 geographical miles due south of Australia); Cape North, in South Victoria Land, though situated fourteen degrees east of Adelaide, is only 35 degrees, or 2,160 geographical miles south of the parallel of that city; besides other minor islands to the south-west and south-east of Australia. Likewise we must bear in mind that though no land nearer to Australia than New Zealand would present an actual ice cliff from which mountains of ice would be discharged. Nevertheless, at least down to the 45th degree of latitude, the surface temperature of the ocean for something like eight months in twelve would be, if not quite, pretty near that of the freezing point, which would tend in a much greater degree than at present to facilitate the passage of icebergs discharged from southern lands much further north than now transpires. To my mind, in those days the stranding of icebergs on the southern shore line of Australia would frequently happen, and to that cause I venture to ascribe the phenomena of the presence of *erratic boulders*, and probably also the *volcanic bombs* found strewn along our present coastline and elsewhere throughout the *Drift*.

Though I cannot fully hold with those who are of opinion that the South Australian drifts are purely of fresh water, or purely of pluvial origin—and also I may here state I by no means disregard the potent fact that depressions and elevations of the earth's surface in various degrees beyond our conception have and may still be caused by the action of internal agency—nevertheless a careful investigation of the various points at issue in the case before us leads me to conclude that the conditions under which our *Drifts* were laid down were brought

about by "planetary motion." We might also point out at the time when the land of Australia was depressed to the extent of 600 feet below the present sea level our land must have presented a much more diversified insular aspect than now. Moreover, in conjunction with that coincidence, the southern hemisphere being also passing through one of its protracted winters, would lead us to infer a much greater annual rainfall then than we now witness, which in a corresponding ratio would act more extensively to denude and transport to lower situations material building up the once by far more extensively developed *Older Tertiaries*. Ample evidence is still presented, from the presence of numerous outliers, of their once general prevalence throughout the uplands of Munno Para and adjoining districts.

Probable age of the Drift.—As to the question, What is the probable age of our comparatively recent accumulations? I am of opinion that they are older than the boulder clays of the northern hemisphere. No data have been given to show that sufficient oscillation of the earth has taken place since the era of the Northern Drift to warrant a belief that a depression of something like 600 feet so far down as latitude 35 degrees has occured in either hemisphere. Anterior to the period of the northern "boulder clay" we have strong evidence advanced—the *Buried River Channels* of Great Britain and other northern countries—that the land over a great part of that hemisphere stood much higher in relation to the sea than it does at present. Therefore, if the theory upon which my argument is based be correct during the geological epoch immediately preceding the glacial, whilst the land in the northern hemisphere stood higher it accordingly would stand lower in the southern, in all likelihood it was during that round of time our so-called *Drifts* were deposited.

We might also—I think with some degree of propriety—refer the age of our "Marine Limestone Crust" of Dry Creek Junction and elsewhere throughout the Province as being contemporaneous with the period of the growth of the now *Submarine Forests* and *Peat-beds* of Europe, which Dr. Croll considers to have flourished about 22,000 years ago.

Explanation of Hand Specimens.

No. 1. Hand specimen of Travertine, or Calc-tuff, from the bed of Smith's Creek, Section 4,160. Substance arranged concentrically around a common centre. Many of the layers, it will be observed, are much denser than others. The darker ones may have derived that hue from an intermixture of the finer particles of dark vegetable mould, caused intermittently either by the action of winds or flood-waters whilst the concretive process of the limy matter was in progress.

No. 2. From the same place. Very much less compact in structure. The denser side represent the upper *in situ;* consequently it has always been exposed to aqueous and aerial influence.

No. 3. Foliated Travertine. From observation I am inclined to infer that this structure of travertine occurs most frequently where the formation closely approaches the surface, or is altogether exposed. Section 4,160.

No. 4. My observations lead me to believe that the segregation of these structures from the surrounding Drift material progresses more rapidly when the subsoil, which is the stratum in which they generally occur, is by some means for the time being exposed to the atmosphere. Southern side of Section 4,159.

INTRODUCTION TO THE

CLIFFS AND ROCKS AT ARDROSSAN, YORKE'S PENINSULA.

By OTTO TEPPER, Corresponding Member.

The geological formations at Ardrossan, situated on the eastern coast of Yorke's Peninsula, present some interesting points, there being preserved here, not only deposits of the oldest Tertiary formations hitherto known in the southern parts of South Australia, but others showing more or less metamorphic action and fossil remains, adjacent to rocks of a highly crystalline character resting upon granite or intruded by it. Though all the rocks mentioned in this paper may be studied at some point or other within a mile or two of the coast, yet the difficulties in the way of exact determination are considerable, there being few places where underlying strata are exposed, hill and dale inland being mostly covered with dense mallee scrub, or, where this is absent, the almost universal surface limestone (travertine) and clay veil the older deposits. Thus a good deal has to be inferred from what can be observed at distant localities.

The accompanying plans, diagrams, &c., illustrate the results of my observations. Fig. 1 is a plan showing the topographical details of most deposits, as observed at the surface. Fig. 2 represents the relation of the strata in the direction of the line forming the northern boundary of Section 77. Fig. 3 represents the intercalation of some limestones and a silicious rock not observed elsewhere and to be described in due course. Figs. 4 and 5 illustrate details of the uppermost portion of the fossiliferous Tertiary rocks; fig. 4 showing the first appearance of the "Turritella grits" *under* the "Ardrossan clays and gravels;" and fig. 5 the several constituent layers of the same, being chiefly interesting on account of the fact that the "Ardrossan clays," while at Ardrossan forming the foot of the sea cliffs, the "grits" appear at the summit—here suddenly assume the place of the upper portion of the "grits," ending abruptly, but not divided by any *distinct* line of demarcation, which has induced me to consider these characteristic red and white clays as the lowermost member of the newer Tertiary strata, produced by the disintegration of the older Tertiary rocks.

Newer Tertiaries.

The surface soils of the less elevated tracts along the coast and in the interior are recent deposits, formed by the disintegration of the rocks of the locality. They consist either of a sandy loam or else an adhesive clay, varying from six to fifteen inches in thickness (figs. 2 and 3). Limestone concretions succeed these, varying in thickness from one to eight feet, and consist of a more or less intimate aggregation of sub-globular bodies from the size of a pea to that of billiard balls, and larger. Where closely cemented they form the so-called "Limestone crust" of the lower parts, sometimes apparent on the surface, where the soil has been removed by atmospheric agencies (fig. 2 under "Ardrossan"). Another kind of limestone, viz., Travertine, is found on the summit of the hills and on their sides, but always in situations nearly horizontal. It occurs in thin layers, denser, heavier, and darker in colour than the preceding, and frequently containing numerous fragments of the oldest rocks of the neighbourhood, sometimes sharp-edged and sometimes rolled. (Figs. 2 and 3 centre, and on hill top.) Both limestones seem to be of recent formation, but the latter appears to be the older on account of its greater density, and formed probably under different conditions, for example, greater abundance of water. In neither have any fossils being detected.

Pleistocene.

The section of the coast cliffs (fig. 2) shows below the concretionary limestone a series of clays and gravels, containing pebbles of granite, hornblende, mica slate, sandstone, &c., and also of the Tertiary grits with their characteristic fossils. False bedding is observable throughout, proving a turbulent state of affairs during deposition. Amongst the *adhesive* clays of this series thin, parallel bands of white pipeclay appear frequently, to the number of three or four, and are persistent for considerable distances. The total thickness of this stratum may be estimated as ranging between twenty and thirty feet. It is, for reasons indicated above (principally as containing pebbles and fossils of Older Tertiary rocks), certainly of more recent origin, but whether it forms an upper member of the Middle Tertiaries or be of Post-Tertiary origin, is uncertain, as no fossils have been observed.

Older Tertiaries.

Ardrossan Clays and Sand-rock.—The stratum underlying the preceding (apparently conformably) consists of variegated red and white arenaceous clays and sand-rock, interstratified with gravel bands of very characteristic aspect. For this reason they are designated "Ardrossan clays" in the accompanying

sections, &c. The boundary between this and the preceding
stratum is not very distinct, when viewed closely; but is quite
conspicuous when seen from a short distance. Throughout
their whole vertical extent the part of the cliff, formed by
these clays, exhibits when dry a vertical cleavage like starch.
The enclosed fragments in the bands of sand and gravel are of
all sizes and degrees of wear, notwithstanding the difference of
hardness of such rocks as granite, mica slate, &c., and suggest
the idea that the whole has not been transported hither from
distant localities, but produced by the chemical disintegration
of a previous rock of lower Micene or upper Eocene age, as
testified by the fact that the largest fragments occur at almost
regular levels, containing numerous fossils and casts, princip-
ally of *Turritella Aldingæ* (Tate), characteristic of the succeeding
layer, to be described hereafter. The whole being strongly
impregnated with saline ingredients, everywhere perceptible to
the taste, and frequently forming a glassy crust upon the face
in protected localities, appears to strengthen materially this
assumption. What these saline substances are, has not been
ascertained, but they do not appear to consist of pure chloride
of sodium; efflorescences of these have been observed forming
stars of needle-like crystals, colourless, transparent, and
diverging under a low angle. Some *Turritellæ*, &c., and an
Echinus have been found at various levels, and not damaged by
rolling or grating, which would have been the case had they
been carried hither by currents of water. Having observed
these clays in one locality overlying the succeeding bed conform-
ably, at another abruptly taking the place of the upper portion
(figs. 4 and 5) thereof, has induced me, together with the other
observed facts mentioned above, to consider them as the upper-
most member of the Older Tertiary strata. Their maximum
thickness does not exceed, where observed, fifty feet, while the
parallel average may be about twenty-five to thirty-five feet.

Turritella Grits.—Ascending from Ardrossan any of the
neighbouring low hills we meet near their summit with frag-
ments of a peculiar fossiliferous rock, the "Turritella grits,"
as I propose to name it. It is a silicious rock of very variable
aspect, passing in density through all stages between opaline or
chalcedonic grit to soft, friable sand-rock, most frequently
having an intermediate character, very hard and very brittle.
Near Ardrossan and northward to Clinton (15 miles), it occurs
near the summit of the hills, occasionally capped by the
travertine limestone, seemingly in no relation to the clays, as
no section is available *in loco*. But southward between Rogue's
and Muloowurtie Points (fig. 4) the same rock appears (in
beautiful section represented by fig. 5, and forming m
romantic cliffs) *under* the foregoing strata in its

colours in extended thin broken bands of grit containing (nay even almost formed of) very numerous casts of *Turritella Aldingæ* (Tate), several bivalves, &c., and alternating with bands of marl, clay, sand, &c., of about equal, but sometimes larger, dimensions, viz., varying between a few inches to a foot and a half, as partially illustrated by figs. 4 and 5, outline sketches of part of the face of the cliff between Rogue's and Muloowurtie Points. For fossils the immediate neighbourhood of Ardrossan has been well examined, and casts and impressions of a limited number of molluscs obtained, viz., *Turritella Aldingæ* which occurs in immense profusion, and its casts (frequently found delicately moulded in hyaline quartz, resembling fairy corkscrews), sometimes form the largest portion of a rock specimen; other univalves, occurring rarely, are species of *Voluta*, *Cassis*, *Natica*, *Cypræa*, *Dentalium*. Of bivalves several species of *Pecten*, *Chione*, and *Pholas*. *Holaster*, and one or two of other species, a cast of *Pentacrinus* (small), and numerous fragments of *Eschara* and *Retepora* nearly exhaust the list. An impression of a leaf of some dicotyledonous tree (*Cinnamomum* probably) and three specimens of fossil wood of as many species complete the catalogue of vegetable remains found.

These "Turritella grits" seem to occupy a narrow strip along the coast, having been observed only for about one mile to one and a half miles inland, occupying everywhere the position illustrated in figure 2, viz., at or near the hilltops from a point a little south of Ardrossan to near Clinton, where it was observed at a single place, but not ascertained whether extending farther north; while below the line of sea level, at a place further south, near Rogue's Point, it emerges at a low angle (two or three degrees) from below this level (fig. 4) underlying the Ardrossan clays and gravels. The only way this can be explained appears to be that during the close of the deposition of the local Tertiaries, and preceding or during that of the Ardrossan clays, an upheaval of the northern part of Yorke's Peninsula took place which did not affect the region extending to the south of Rogue's Point. The Turritella grits occur at Ardrossan, apparently above a felspathic sandstone. This rests upon marbles, which are succeeded by undoubtedly Palæozoic rocks, finally abutting upon a granite which extends—to judge by the character of vegetation—to within two miles of Maitland, where the gneissic rocks and the same felspathic sandstone again appear.

Muloowurtie Clays.—The succeeding layers to the "Turritella grits" appear to be absent at Ardrossan, except the next underlying it, which on account of the difference of level between the upper observed surface of the sandstone mentioned (to be

described hereafter), and the lowest part of the "grits" has been introduced in fig. 2 under the name *Ochreous Clay*, but as this and the other deposits are seen at another locality in normal juxtaposition, the following applies to the same, viz., the coastline in the Hundred of Muloowurtie, between Rogue's and Muloowurtie Points.

About one and a half miles south of Ardrossan, the strata forming the coast cliffs thin out or curve downwards to within a few feet of high water mark, and re-appear afterwards at Rogue's Point with an ascending angle of about two or three degrees, measured in the direction of the coast, viz., nearly N. to S. Two miles further the whole series shows several curvatures, the height of the cliff at the same time decreasing rapidly from 70 or 80 feet to fifteen or twenty, and close by marbles appear above the sea level underlying unconformably the above. Near Muloowurtie Point a peculiar sandstone occupies locally either the lower part of the "Ardrossan clays" or the upper of the "Turritella grits," most likely the latter. It consists of small, equally-sized round grains of pure silica, resembling very much, where weathered, the roe of fish. Its dimensions vertically are inconsiderable, being only a few feet in thickness, and contains no fossils.

Some distance further south a thin layer of ferruginous sandstone appears instead, containing abundantly casts and impressions of large *Turitellæ* and small bivalves (cockle-like). In structure it resembles exceedingly the so-called Upland Miocene ironstone near Tanunda, Nuriootpa, &c.; but at these places *no* undoubted fossils as far as I know are associated with the same, excepting some specimen of wood transformed into oxide of iron, obtained by me. A similar rock has been observed by me, but without fossils, in a small patch in Section 214, Maitland, Yorke's Peninsula. Between Rogue's Point and Muloowurtie Point the base of the series of older Tertiary strata occurs at sea level, resting on the Ardrossan Marble, and is succeeded by the rest up to the "Turritella Grits" at 40 feet elevation. The "Turritella Grits" have (fig. 5) here a thickness of some 20 feet, the greatest measured vertical thickness being 26 feet 6 inches; and consist of two or three distinct unfossiliferous clays and bands of grit from three inches to a foot in thickness, the uppermost and the lowest of which can be traced for long distances, while the intermediate ones partly change into white marls or cease and re-appear irregularly, or disappear altogether. They alone contain fossils, and all of the same description. Immediately, below and conformably thereto, follows a layer of ochreous clay (fig. 5) without fossils, and of a thickness (where measured) of six feet six inches, but much more at other places. This overlies, likewise conformably, a

soft, arenaceous, yellow clay, changing to sandrock of variable dimensions, viz., from nine to twenty feet. From it have been taken specimens of *Terebratula* and other molluscs, all totally different from those of the Grits. It is succeeded by a whitish, plastic, sandy clay, or clayey sand, abruptly separated from the preceding by a seam of hard arenaceous limestone only one inch thick. This bed contains numerous small fossils, *Fibularia gregata* (Tate), small Pectens, &c., and overlies a yellow clay, containing abundant specimens of *Ostrea*, *Avicula*, *Pecten*, *Echinoderms*, &c., and even some teeth of fishes have been obtained. It seems a remarkable fact that the fossils in these lower layers should have preserved the original structure of their shells, though very brittle; while those in the upper grits have been changed into silicates, or dissolved away.

At Muloowurtie Point the last-mentioned clay rests directly and unconformably upon the crystalline limestone called "Ardrossan marble" (C, fig. 2) in undulating curves, and several of the upper members of the series thin out and disappear gradually. The total aggregate thickness of the whole series of the lower clays may be estimated at not much exceeding 40 feet, where observed. As to what age these lower clays belong, the following remarks may not be out of place:—Some specimens of the "Turritella Grits" having been submitted to Professor Tate, F.G.S., President of this Society, I was favoured by him with the information that he identifies their characteristic fossil with that of a member of the lowest fossiliferous series at Aldinga, the oldest Tertiary strata hitherto known in South Australia, and belonging to the Eocene period; therefore, as none of the fossils hitherto discovered in the lower clays at all resemble those of the grits, and embedded in a lower stratum, these clays may ultimately prove to be of still greater age.

Lower Silurian.

At the elevated parts near Ardrossan the local Tertiaries overlie unconformably, as stated above, a firm, felspathic sandstone and grit, designated "Ardrossan Sandstone" (B, figs. 2 and 3). This sandstone is sub-crystalline in texture, fine grained in the upper, and coarse in the lower portions, and of greyish white colour, and occasionally coarse and even conglomerate. The upper portions show false bedding distinctly, and separate into large blocks, while the lower present a distinct cleavage at nearly right angles to the plane of deposition. It is quarried on Section 77 (see fig. 1) for building stone, for which it is well adapted. The measurements taken there gave the following angles, viz.:—Dip, 15 degrees easterly (average), and strike N. 63 degrees E. The same rock also forms escarpments on the seaward faces of the hills in Sections 33, 31, &c.,

overlying unconformably for some distance directly the Ardrossan Marbles. Its thickness seems nowhere considerable, 20 feet being probably the maximum. Throughout the whole extent of this sandstone no fossils have been observed, except some holes resembling those of *Pholads*.

South of Parara Station, Sections 31, 22, 21, &c. (fig. 1), some peculiar strata intervene between the "Ardrossan Sandstone" and the Marbles, viz., a variegated and a dark-coloured limestone, and white and yellow marbles (fig. 3), conformable with the "Ardrossan Sandstone" and each other, but unconformable to the marbles. The planes of stratification are so obliterated in the exposed portions, that their angle of dip has only been surmised from the general agreement of their exposed faces in vertical distance from each other and the "Ardrossan Sandstone," in any section from E. to W. But this is not the case in the direction N. to S.; on the contrary, here the lowest bed appears first on the summit of the hill in Section 31 (see fig. 1), and subsequently the others, attaining gradually larger dimensions. In Section 21, to which only my observations extend, the lower white and yellow crystalline limestones occupy the lowest depressions, concealing the marbles entirely. Not having at all observed it further south, it seems to be of local occurrence only, perhaps filling up an ancient valley or basin; but my observations are not sufficient to pronounce a decided opinion. Both varieties of the upper marbles contain distinct fossils and abundantly minute fragments of such, but the upper one by far the most, conspicuous among which occurs a trilobite, and coral structure appears to perfection in sea-rolled pebbles, when the fossil shows in beautiful contrast of colour upon the smooth surface. Professor Tate holds the tentative opinion that the fossils are of Lower Silurian age. The dense, light-coloured marble seems to contain no fossils.

Pre-Silurian.

The "Ardrossan Marbles" form the basement rock fro
Ardrossan to Muloowurtie Point, along the coast. T
consist of yellowish or pink coloured (*not* variegated) sacch
limestones (figs. 2 and 3) with well-developed jointi
obliterated stratification. At the surface disintegr
rubble, a short distance below they form large s
seemingly well adapted for ornamental build
being capable, on account of their fineness
receiving a beautiful polish—especially the p
almost limitless supply could easily be obt
wurtie Point, where it forms the foot of
sea level, this limestone is interstratifie
iron ore, assuming, by atmospheric ar

polish, exhibiting finely the irregular reticulated structure. No fossils have been observed (dendritical moss-like figures cover, more or less profusely, the cleavage planes). The thickness of the stratum is very considerable, but has not been ascertained numerically. Dip 59½ degress easterly; strike N., 8 degrees E.

The costeening pits of the Parara Mine reveal the upper portion of grey Micaceous Slates, extending for several hundred yards E.W., otherwise concealed by the surface deposits. Dip, 59½ degrees to 71 degrees easterly; apparent strike, N., 5 degrees W. A dark talcose schist occurs in the talus of the same mine. (Figs. 1 and 2.)

The Micaceous Slate is succeed by a dark green Chloritic (or talcose) and Hornblendic schists, several hundred feet thick, with an increasing dip of about 73 degrees easterly average; strike nearly N.S. (Plan 2, section 3.)

These schists directly abut upon a coarse porphyroid granite. (figs. 1 and 2.) The component, whitish or red felspar, is greatly in excess of the white or smoky quartz. Mica is sparingly disseminated through the mass in lamina of medium size, while black tourmaline crystals intermix with the whole. The character of the granite is intrusive, alternating with Mica Slates and Hornblende schists as far as I could trace it—that is about two miles—forming dykes from less than a yard to several hundred feet. To judge by a shrub, *Melaleuca uncinata*, I only observed growing on granite soils, the granite extends to within about two miles of Maitland, *i.e.*, about ten miles E.W., but is hidden by the surface clay and travertine. Two miles south of Muloowurtie Point, at Hart's Mine, it forms the foot of the Coast Cliff, consisting there almost of pure red felspar.

The following synopsis of the rocks observed represents my idea of their succession in time:—

Newer Tertiary	1.	Surface deposits.
	2.	Limestone concretions (on lower levels).
	3.	Travertine (on higher levels).
	4.	Clays and Gravels.
Older Tertiary	5.	Ardrossan Clays and Sands.
	6.	Turritella Grits.
	7.	Muloowurtie Clays.
Lower Silurian	8.	Ardrossan Sandstone.
	9.	Parara Limestone (fossiliferous).
	10.	White and yellow unfossiliferous silicious limestone.

Pre-Silurian	11. Ardrossan Marbles. 12. Micaceous Slates. 13. Talcose, Chloritic, and Hornblendic Schists.
Plutonic	14. Granite.

NOTE.—The Ferruginous Shales represented in fig. 2 as overlying the "Micaceous Slates," have since been ascertained to be decomposed portions of them.

Note on the Artificial Production of Crystallised Atacamite.

By T. C. Cloud, Assoc. Roy. Sch. Mines, F.C.S., &c.

[Communicated by the President.]

It is well known to chemists that the hydrous oxychloride of copper is produced when oxide of copper is acted upon under favourable conditions by certain soluble chlorides, notably those of ammonia and sodium, but hitherto the attempt to obtain this substance in the form of definite crystals has not been successful. I have, however, to record the conditions under which I have found this substance produced. At the Wallaroo Smelting Works there are large underground culverts connecting the various smelting furnaces with the stack. From certain of these furnaces a substance is produced which deposits in the culvert. This culvert-deposit consists almost entirely of cupric oxide, with a small proportion of an hydrous cupric sulphate. At one part of the culvert there is a small, but constant infiltration of seawater, which in contact with the culvert-deposit above described, and under the influence of the high temperature necessarily existing in such a culvert, has in the course of not more than twelve months produced the hydrous oxychloride of copper in a crystalline condition.

The crystals were found between separated layers of the culvert-deposit, which at this point of the culvert was almost entirely converted into a massive hydrous oxychloride of copper. The crystals were not large, the largest being about one-twentieth of an inch in diameter. An examination of these under the microscope showed that the crystalline form was a combination of rhombic, prism, pyramid, pinacoid, and domes; in fact, the exact form of Atacamite.

The colour was rather lighter than most specimens of the natural mineral that I have met with. A chemical examination was not made, as it was found practically impossible to obtain a sufficient quantity of the crystals free from the massive deposit upon which they were formed, and as this portion contained a quantity of more or less unaltered deposit, its presence in the sample taken for analysis would have vitiated the result.

Having due regard, however, to the conditions under which this substance was formed, and also to its appearance and crystalline character, I think I am justified in stating that we have here an instance of the artificial formation of crystallised Atacamite.

FIGURE 1.

SCALE

SURVEYOR GENERAL'S OFFICE, ADELAIDE. Frazer S. Crawford, Photo-lithographer. (8.873)

Plate 3.

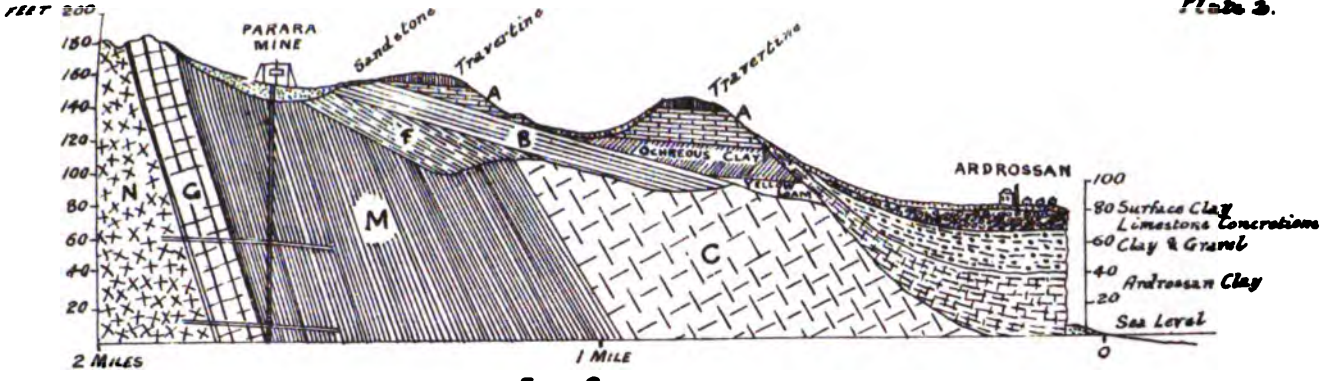


FIG. 2.

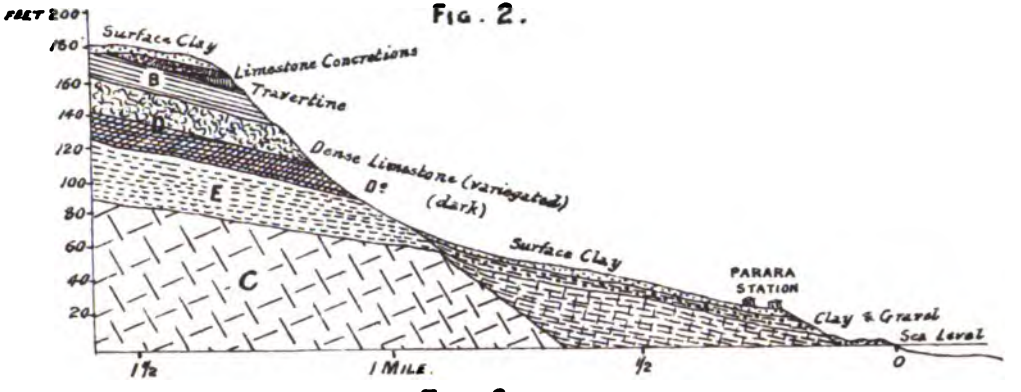


FIG. 3.

SURVEYOR GENERALS OFFICE ADELAIDE Fraser S. Crawford, Photo-lithographer.

Plate 3.

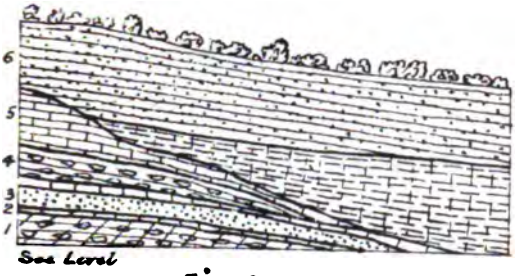


Fig. 4.

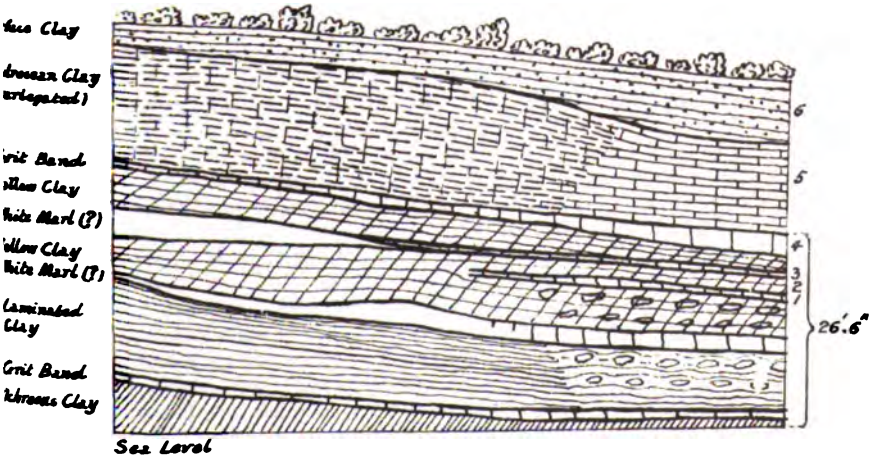


Fig. 5.

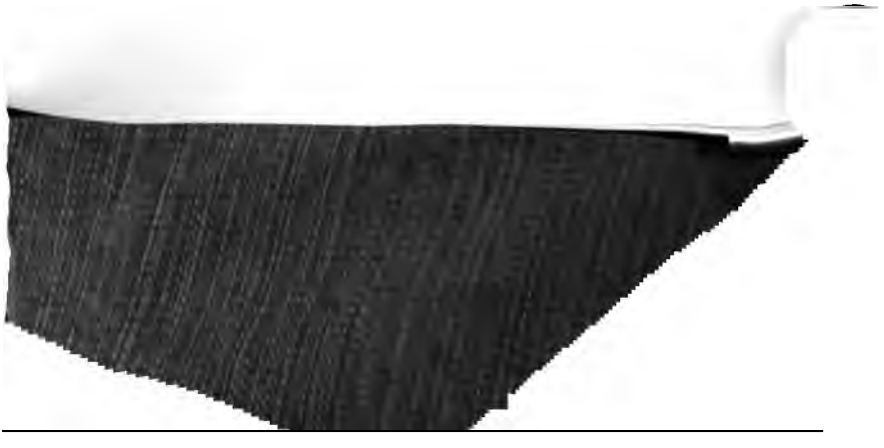
SURVEYOR GENERAL'S OFFICE, ADELAIDE. Fraser S. Crawford, Photo-lithographer.

THE ABORIGINES OF SOUTH AUSTRALIA.

By J. D. Woods.

[Communicated by the President.]

Nearly three hundred and forty years have passed away since Portuguese enterprise made known to the world the existence of the Australian continent. More than 100 years ago Captain Cook took possession of New Holland in the name of King George III. An immense number of natives with their possessions came under British rule. But while the country has expanded into a number of States which occupy a splendid position in the family of nations, the native races have in a great measure passed out of existence, and their history can only be traced with difficulty through the scattered and imperfect records which private persons have left behind them. The mode in which the first Australian settlement was commenced and carried on for years was not favorable to any scientific consideration of the Australian savage as a portion of the human family. His occupation of the soil was more an accident than a part of a grand providential design. His land was handed over to men who could show no claim to it except that which rests on the right of the strong. The blackfellow came before long to be looked upon as an interloper, one who had no right even on the soil, and his life was held of little more account than that of the kangaroo, which constituted a chief part of his daily food. A learned Judge in Tasmania in the early days formally decided that the lessee of a sheeprun could prevent aboriginal natives from "trespassing" on the land included in the lease. Botany Bay, where Cook first put foot on shore, was inhabited by a large native population. They offered no serious resistance to his landing, but those who were present at that time showed at least that they did not hail the new arrivals with much satisfaction. The actual occupation of New Holland by the English did not take place for many years afterwards. Captain Phillip, R.N., who founded the first settlement in 1788, was met by a large number of aborigines, who at first made a slight demonstration against the new comers, but their weapons were soon laid aside, and they became friendly with the intruders. This is the substance of the accounts of the Australian natives who first came into contact with the white men.



The physical characteristics of the natives who inhabited the eastern shores of Australia in those days, as far as any note was taken of them, appeared to be in all respects similar to those of the tribes who have occupied the coast line in other parts of the continent. The men were tall and well formed. They had broad foreheads, wide mouths, small piercing eyes, flattened noses, and thick black hair. Their chests were deep, but their lower limbs thin and ill-developed as compared with those of average Europeans. They were remarkable for the beauty and strength of their teeth, for the boldness of their carriage, and for the comparative smallness of their hands and feet. Although perfectly black, they were different in appearance from the natives of Africa, wanting the woolly hair and the great thickness of lips for which the latter are remarkable. The women were smaller than the men: in appearance worse looking, and with frames not so well developed. The aborigines all round the Australian coastline bear the same description, and are supposed to have sprung from one source.

This supposition is to a great extent confirmed by a general uniformity of customs, a similar uniformity in the laws which govern the relationships of individuals to members of their own tribes, and to those of the tribes to which their parents belong, and also by the uniformity in those laws which apply to the possession and occupation of territory. Their weapons are generally similar, everywhere consisting of spears, shields, boomerangs, wooden axes and waddies, or clubs. The Botany Bay natives had bows and arrows. These are uncommon. In some portions of Australia the spears are pointed with flint or stone heads and barbs, and the natives in some places use flint knives and stone hatchets or tomahawks, the heads of which are fixed into cleft sticks, and secured with a rude kind of cord firmly kept together by some resinous substance. On the seashore canoes made of bark are commonly used for fishing, but only where the indigenous trees are large and abundant, and access to the beach is easy.

The languages, or rather the dialects, which are or were in use in those portions of the country which have been opened out by the progress of settlement afford strong presumptive evidence of a common origin. Although far from complete they are sufficiently numerous to furnish satisfactory basis of comparison, which have led those who have investigated the question to the belief that they are no more than modifications of one form of speech which some peculiar customs have called into existence. One of these is the practice of never uttering the names of dead persons. Now as the names of the natives are mostly the names of some natural features of the places in which the bearers are born or after some creature or special

occurrence, the death of a person necessitates a change in the name of these also, and the new names in time become fixed terms in the language, instead of serving as a temporary expedient. The effect of this when in operation amongst hundreds of distinct tribes can easily be imagined. The marriage ceremonies vary to some extent amongst different tribes. In some cases the wives are stolen from other tribes, in others they are sold or given away. In nearly all cases they are promised or disposed of whilst still children or even infants, and the promise is almost universally rigidly performed. If the first husband should die the woman belongs to his heir—that is, a brother succeeds to the wives and offspring of his deceased brother if they both bear the same family name. On this some remarks will be made further on. The stealing of a wife is always avenged as an act of warlike aggression. Where the laws relating to marriage are carried out with some degree of strictness, it might be supposed that the chastity of the females would be respected and preserved. This is far from being the case all through the continent. On the Northern coast it is most rigorously enforced, but in the Central and Southern portions such a thing is not thought of. In fact the orgies which the tribes carry on amongst themselves and amongst other tribes which meet them on friendly terms will not bear description. Mr. Eyre, who was Protector of Aborigines at Moorundie in 1841, treats of this subject at some length. His knowledge of this branch of the social state of the natives could only be recorded in a Latin footnote; but bad as that was, it pales utterly before the horrors continually practised on young females amongst the tribes which occupy the country about the Peake, Tennant's Creek, Alice Springs, the Charlotte Waters, and amongst the Dieyerie tribe. A more fitting opportunity than the present will be taken to record the details of those facts which have been communicated to the writer by trustworthy authorities, and which are as singular as indeed they are revolting. The marriage bond is not considered permanent, a husband bartering away or selling his wife (mostly an old one) whenever by any means he can obtain another. Of course it will be seen from this that polygamy is universal; indeed there is no tribe of which there is any account where it does not obtain; but the wife runs the risk of losing her life if she leaves her husband, and she is recaptured by him or by the tribe.

The funeral customs which prevail amongst different tribes are by no means uniform. In Western Australia the corpse is buried in a grave laid out due east and west, and the face of the dead person is turned to the east. The grave first, however, is purified from the presence of the sorcerer who caused the death, by having

a quantity of branches burned in it. The bottom is strewn with leaves, on which the body is deposited. It is then covered with branches secured by cross sticks, and finally filled with earth. Whilst the burning is in progress an old man of the tribe attentively watches the grave to see in which direction the exorcised sorcerer travels, for that is supposed to lead to the detection of the murderer. Amongst the Adelaide tribe a sort of inquest was held, and the body buried without the formalities above noted; but the position of the grave east and west was preserved, and a small fire at the head of the grave was supposed to keep evil spirits away. Amongst the Murray tribes and those belonging to the country around Encounter Bay the corpse was smoked until dried, and then deposited on a platform in a tree out of the reach of wild dogs. The Central Australian tribes eat their dead to prevent the survivors sorrowing for them. The body is taken to the grave, and amongst the Dieyerie, at least, a sort of inquest is held to discover who killed the deceased, after which the flesh is cut from the muscular parts of the body and distributed amongst the tribe to be eaten. There are certain rules by which this shocking practice is regulated. Fathers do not eat their children, but the mothers do. Other relatives eat each other indiscriminately, except that sons do not eat their parents' flesh, &c. The other tribes in the Interior of which the writer has any accounts are all addicted to the same cannibal customs. All deaths are looked upon as the result of witchcraft, and are avenged accordingly on some member of another tribe. When a child dies the mother eats the head, and the children in the camp are fed with the foul diet to cause them to grow. When grown persons die those who eat the corpse take those portions wherein they think the deceased person's abilities or distinguishing characteristics are supposed to have been located. Infanticide has prevailed all over the continent for the sole purpose, it seems, of leaving the wife free to attend upon the husband who for the time may happen to own her. The practice of polygamy and of infanticide, as well as the prevalence of other customs which cannot be mentioned here, have contributed greatly to keep the tribes from increasing to any great extent. To those who know what these have been in former times, and what they are now, where the tribes are numerous, it is a matter of wonder that they have continued to exist so long as they have done. Amongst all the tribes wherever they have been found there are special rites and ceremonies which must be undergone by youths before they can be considered to be men. The old men are in all cases most watchful on such occasions lest their proceedings should be witnessed by strangers, but no woman is suffered on pain of death to see what is done, or to

come near the spot where the strange performance takes place. In some localities the rite of circumcision is all that is necessary. This is the case amongst the tribes near and beyond the Peake. Amongst other tribes, as in Western Australia and the southern part of this colony, the youth is inducted into manhood by many stages, the last of which is not reached until late in life. In some parts of the continent circumcision is not practised, but the tribes that omit this custom are not very numerous. The tribes living about Alice Springs, Charlotte Waters, and in the adjacent portions of the country have customs by which young females become women and are permitted to marry. The treatment they undergo on these occasions has doubtless a powerful influence in checking a rapid multiplication of the scions of the tribes, and from its nature must not unfrequently end in the deaths of some of those who are subjected to it. In a paper like this it is impossible to enter into the particulars of many of the customs, which plainly show how low in the scale of humanity the Australian savage stands. At the same time they cannot be altogether ignored. Without pursuing the subject further on this occasion it may suffice to say that the inner life of some of the Australian tribes is made up of the most barbarous cruelties and the most loathsome obscenities that can be conceived even of a savage people. In spite of this the children that are permitted to survive are treated with the greatest kindness and affection. They are well fed and carefully instructed in all those essentials which can fit them to become useful and productive members of the community of which they form a part. This all ceases when they reach the adult stage of life. The male becomes then subject to all the laws and disabilities of the tribe, and the female is the slave of him who takes, buys, or steals her in marriage. He has the power of life and death over her, and this is not used with a sparing hand.

The *corroboris*, as it is called in New South Wales, has the same characteristics throughout Australia. At times it partakes of a festal character; at others it forms sort of a warlike demonstration. One phase of it is too disgusting for description. The festal gatherings amongst strange tribes very often end in fights. These corrobories are mostly held at or near the full moon, and they form a strange and interesting sight when the natives are numerous and peaceably inclined towards each other. The Peake and Charlotte Waters tribes are divided into four classes of families or subtribes, called the Parulà, the Pooningà, Pultarà, and Coomarà. A Parulà can only marry a Pooningà, and their children only become Pultarà or Coomarà. If the Parulà is the father, the children are Coomarà; but if the mother, the

offspring are Pultarà. A Pultarà may only marry a Coomarà. If male the children are Pooningà, if female Parulà. Similar rules prevail in Western Australia, in Queensland amongst the southern tribes, and amongst the Dieyerie; no doubt they exist elsewhere. The custom reduced to simple terms is that children of either sex always take their mother's family name, and a man cannot marry a woman of his own family name. Sir George Grey, in dwelling on this circumstance, notices in it a coincidence with customs which prevail amongst the North American Indians. It is stated in Mr. Taplin's work (on the authority of the Rev. Mr. Tison) that it exists amongst the Tamil and Telugu population of Southern India, as well as amongst the natives of Fiji and the Friendly Islands. How it came to Australia is one of those mysteries which probably will never be cleared up.

The natives in general have no notion of accumulating property except as far as relates to their weapons for hunting and war, and those few articles made by the women in their rude domestic economy. In the Interior, however, a sort of trade is carried on amongst distant tribes. In the North one association of tribes supplies another at a distance with shields and other arlicles through the agency of an intermediate tribe, receiving at their hands supplies of red ochre, which is used in some of their ceremonies, but which is not to be found in the country in which the shields are made. The Dieyerie tribe have a sort of trade among themselves, but it seems to begin and end with a love of novelty without leading to accumulation. It has already been pointed out that wives are frequently bought and sold. Some of the tribes that have been met with in the Interior have shown themselves to be peaceable and friendly to white men. Such natives were met with by Bourke and Wills, and some by the Overland Telegraph Construction party, and to a friendly tribe the safety of Colonel Warburton's party was due. As a rule, however, they are hostile to all strangers, cruel, and treacherous. They are, moreover, accomplished thieves, taking by stealth or stratagem any of the coveted articles commonly seen in the hands of white men, when they cannot obtain them by murdering the possessors. From the testimony of writers who had a knowledge of the natives of Australia in New South Wales before the foundation of this province, it seems clear that individual natives actually possessed property in the land on which they lived, as distinct from that of the tribe. The same fact existed in Western Australia, and it was officially stated to exist in South Australia. The evidence is to be found in the second report of a Select Committee of the House of Commons on South Australia. Certain it is that in all cases the intrusion of

one tribe into the territory of another without leave or invitation is regarded as an act of war, and is resented accordingly. If this intertribal custom in connection with the fact of ownership, personal and tribal, could have been impressed upon or had been recognised by those who controlled the process of settlement in the Australian colonies when they were founded it is not improbable that the natives would not have disappeared as fast as they have done. The recognition of the rights of a tribe or of an individual must have entailed some official attempt to preserve the language, in order to make the record of sale or transfer complete, and this again must have brought with it a careful observation of manners and customs, which in a scientific point of view would have been of the greatest value at the present time. The rights of the natives, although enforced against each other, were not enforced against the Europeans, and the result is now before us in the absolute extinction of those tribes who were first associated with Europeans, and the total loss of their language. Amongst existing tribes, and those whose histories have been recorded, there seems to be one system of law which applies to offences of a grave character. Murder is invariably punished with death. There is no known deviation from this rule. Adultery, strange to say, is similarly punished unless it should occur with the consent or connivance of the husband. The intermarriage of individuals of the same family is looked upon as incestuous, and is avenged by death. Amongst the natives at Alice Springs and the surrounding country the punishment inflicted on the offending woman is horrible. She is mutilated with stone knives, and in one instance narrated in a letter in the writer's possession the unfortunate delinquent was so cut about that her bowels came out through her back. The natives, however, do worse than this, and such treatment may be regarded as merciful in comparison with some of the punishments they inflict on such occasions. If a native has killed another his life is forfeited to the tribe of the deceased. If he should die or succeed in eluding the vengeance of those who seek his life his brother or some other relation must suffer in his place. For trifling offences the guilty person submits to have a spear thrust through his leg or arm, an infliction which is held to wipe out all but capital crimes. At this point I must close. Other peculiarities of the Australian savage, relating to his superstitions, his mode of procuring his food, of cooking it, and of the laws which fix its consumption, and its manufacture, would occupy too much of the time of the Society for one evening. On a future occasion I hope to supplement this paper by another and place before the Society some particulars relating to tribes only recently met with i

Northern Australia and Queensland. In the meantime the writer begs indulgent consideration for the imperfections which are manifest in this paper. The communications which were expected from the quarters above mentioned did not come to hand as expected. The preparation of this paper was consequently postponed from time to time, and was eventually completed in some haste.

A List of Australian Starfishes.

By the Rev J. E. Tenison Woods, F.G.S., F.L.S.,
President of the Linnean Soc., N.S.W., Hon. Member of the Adelaide Phil. Soc., &c., &c.

A list of Australian Starfishes has long been a desideratum amongst naturalists. It has been rather difficult to obtain, because of the scattered way in which the various species peculiar to our coasts have been described. The British Museum Catalogue of Gray is very imperfect, and the same may be said of Müller & Troschel's System der Asteriden (Braunshweig, 4to., 1842, with twelve copper plates.) Agassiz's Memories on the subject have never been completed, and at the present day there is no good general work on Starfishes. Quite recently (1878), M. Edmond Perrier, Professor of Zoology (Mollusca and Zoophytes) at the Museum of Natural History in Paris since 1876, has published a very interesting memoir on the geographical distribution of Starfishes (Nouvilles Archives du Museum, 2nd series, vol. 1, p. 1.) The nature of the essay does not permit of any definition of species or genera, but he gives lists of names which will be found very useful to the inquirer. It is pleasing to observe also that he makes flattering mention of the work of Captain Hutton, of New Zealand, the only naturalist who has dealt with the subject in Australasia. In dividing the Pacific region into four provinces Professor Perrier makes the Australian region one and gives us credit for 46 species. I am enabled to increase the number to some extent in the list which I subjoin, but I am fully aware how imperfect it must be since more than 70 have been determined by me in the various Australian collections, public and private, and from specimens found by myself. It will be seen also that I am able to afford information as to the habitat of a very few of the species named, but I propose to follow this brief paper with a much more detailed one, in which I shall furnish bibliographical references. I venture, however, to hope that this very brief enumeration will give some help to students and naturalists who may desire to deal with the subject. I shall be very glad to receive further communications from any one on the subject, who may know of Australian species not enumerated here, so as to make my future list as complete as possible.

Family Asteriadæ.

Genus—Asterias, *Linné*, 82 species.

1. A. calamaria, *Gray*.
   Common in Port Jackson, Twofold Bay, and probably on all the South-East coast of Australia. Tasmania; also in the Mauritius and New Zealand.
2. A. fungifera, *E. Perrier*.
3. A. globifera, *Gray*.
   Tasmania.
4. A. granifera, *Lamarck*.
   Australia.
   With five subterete rays, reticulately granular, longer granules, shot-like. The back is covered with a network of round grains, with granular, smooth-like points, some small, some large, with a small pedicel.
5. A. polyplax, *Muller* and *Troschel*.
   Tasmania.
6. A. sinusoidea, *E. Perrier*.
   Storm Bay, Tasmania.
7. A. tenuispina, *Lamarck*.
   This is a Mediterranean species, and its occurrence in Australia is doubtful. Von Martens is the authority. It has, however, a very wide range, and occurs in Mauritius.

Genus Calvasterias, *Perrier*.

8. C. asterinoides, *E. Perrier*.
   Cape Grenville, Torres Straits, North Australia.

Family Echinasteridæ.

Genus Solaster, *Forbes*, 8 species.

9. S. decanus, *Muller* and *Troschel*.
   S. W. Australia.

Family Linckiadæ.

Genus Nectria, 2 species.

10. N. ocellifera, *Lamarck*.
    It may help to its identification to give its diagnosis. Unarmed, pentagonal angles extended, corniculate; back convex, tesselated with rounded granular, nearly spherical plates.

Family Goniasteridæ.

Genus Anthenea, *Gray*, 7 species.

11. A. acuta, *E. Perrier*.
12. A. tuberculosa, *Gray*.
    Port Essington.

Genus Culcita, *Gray*, 8 species.

13. C. pentangularis, *Gray*.
N. E. Australia. Chevert expedition. West Australia *(Gray)*.
14. C. Novæ Guineæ, *Muller* and *Troschel*.
N. E. Australia. Chevert Expedition.

Genus Goniodiscus, *Muller* and *Troschel*, 9 species.

15. G. seriatus, *Muller* and *Troschel*..
South-West Australia.

Genus Pentaceros, *Linck*, 31 species.

16. P. australis, *Lütken*.
17. P. Franklinii, *Gray*.
18. P. gracilis, *Lütken*.
East Australia.
19. P. granulosus, *Gray*.
West Australia.
20. P. nodulosus, *E. Perrier*.
21. P. valvulatus, *Muller* and *Troschel*.
South-West Australia.
22. P. turritus, *Linck*.
N.E. coast, Cape Grenville; Port Essington *(Tate)*.

Genus Pentagonaster, *Linck*, 94 species.

23. P. paxillosus, *Gray*.
Port Essington.
24. P. inæqualis, *Gray*.
Endeavour River.
25. P. spinulosus, *Gray*.
Port Denison, Cleveland Bay.
26. P. (Dorigana) Dubeni, *Gray*.
West Australia. South Australia *(Tate.)*
27. P. (Dorigona) Gunnii, *E. Perrier*,
Who gives the locality George Town, Australia, probably meaning George Town at Port Dalyrmple, Tasmania. The species is found on the Victorian coasts also.
28. P. (Dorigona) pulchellus.
New South Wales coast, Tasmania, and New Zealand.
29. P. (Stellaster) Belcheri, *Gray*.
North-East Australia, New Guinea.
30. P. (Stellaster) Childreni, *Gray*.
Port Darwin, Cape Cleveland.
31. P. (Stellaster) granulosus, *E. Perrier*.
New South Wales.
32. P. (Stellaster) Incei, *Gray*.
South Australia, King's Island, Cape York.

33. P. (Tosia) astrologorum, *Muller* and *Troschel*.
34. P. (Tosia) auratus, *Gray*.
35. P. (Tosia) australis, *Gray*.
West Australia. South Australia and Tasmania *(Tate)*.
36. P. (Tosia) grandis.
West Australia.
37. P. (Tosia) magnificus, *Muller* and *Troschel*.
Tasmania and Bass' Straits. Apollo Bay?
38. P. (Tosia) nobilis, *Muller* and *Troschel*.
Manly Beach, New South Wales? South-West Australia.
39. P. (Tosia) ornatus, *Muller* and *Troschel*.
Port Stephens or Moreton Bay?
40. P. (Tosia) ruber, *Gray*.
South Coast?
41. P. (Tosia) tuberculatis, *Gray*.
Swan River and Champion River, West Australia.

Family Asterinidæ.

Genus Asterina, *Nardo*, 28 species.

42. A. calcar, *Lamanarck*.
This species is very common all along the south coast, and in N. S. Wales as far as Port Jackson. Tasmania?
43. A. exigua, *Lamarck*.
The same localities, and extending into Tropical Australia. It is also found at the Cape of Good Hope, Java, the Mollucas: Very small; pentagonal, convex, with very minute pores; concave papillose below.
44. A. Gunnii, *Gray*.
All the south coast and Tasmania.
45. A. regularis, *Verrill*.
Australia, and in New Zealand.

Genus Patricia, *Gray*, 2 species.

46. P. crassa, *Gray*.
West Australia.
47. P. ocellifera, *Gray*.
West Australia.

Family Astropectenidæ.

Genus Astropecten, *Linck*, 62 species.

48. A. polyacanthus, *Muller* and *Troschel*.
Very common in Port Jackson.
49. A. trisseriatus, *Philippi*.
South-West Australia.
50. A. Pressii, *Muller* and *Troschel*.
West Australia; South-West Australia *(M. and T.)*

51. A. VAPPA, *Muller* and *Troschel*.
South-West Australia *(M.* and *T.)*. Port Jackson. I am not certain of this identification; it may be an undescribed species.

GENUS ARCHASTER, *Muller* and *Troschel*, 9 species.

52. A. ANGULATUS, *Muller* and *Troschel*.
Port Darwin. Torres Straits.

53. A. TYPICUS, *Muller* and *Troschel*.
Cape Grenville, Endeavour River, Port Darwin.

THE NATURAL HISTORY OF THE COUNTRY AROUND THE HEAD OF THE GREAT AUSTRALIAN BIGHT.

By PROFESSOR RALPH TATE, Assoc. Lin. Soc., F.G.S.., Corr. Memb. Roy. Soc. Tasmania, Acad. Sc. Philadelphia, &c., &c., President.

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1. Natural Divisions of the Country around the Head of the Bight.
2. Boundaries of the Bunda Plateau.
3. Previous Explorations in, and writer's route.
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   (1.) Introduction.
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6. The Newer Tertiaries around the Head of the Great Bight.
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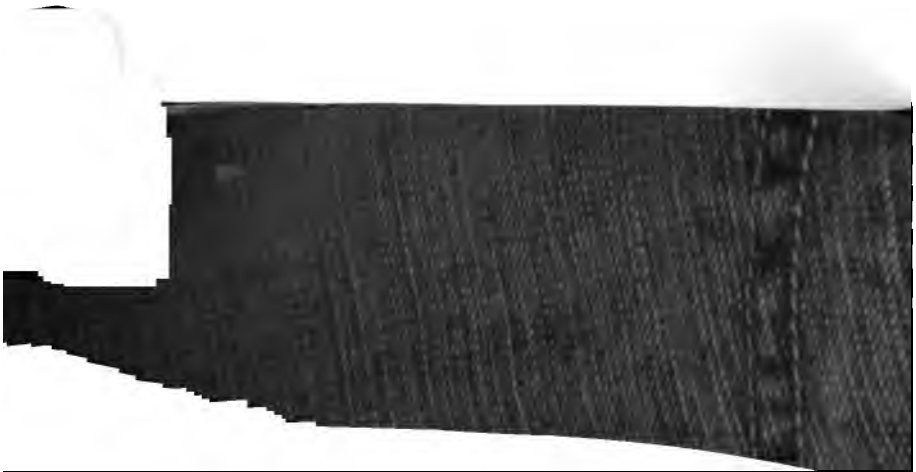
9. Sketch of Zoology of the Bunda Plateau.
10. Marine Conchology around the Head of the Bight.

NATURAL DIVISIONS OF THE COUNTRY AROUND THE HEAD OF THE BIGHT.

The western portion of the country which lies around the Head of the Great Australian Bight is almost a *terra incognita* to the naturalist, though its topography is fairly known. Because of its unique structure, and co-ordinate peculiarities in its fauna and flora, it claims our chief interest. The eastern portion is not devoid of interest, but it lacks the novelty of isolation and inhospitality; its leading characters are those of the whole region extending to Spencer's Gulf. In this paper I confine myself almost exclusively to the western portion, to which I have given the name of the Bunda Plateau, but incidental references are made to the other.

BOUNDARIES OF THE BUNDA PLATEAU.

They are on the south, the line of perpendicular sea-cliffs which stretch in an unbroken and inaccessible wall, commencing at three miles west from the Head of the Great Australian Bight to the headland called Wilson's Bluff, on the frontier of West Australia, and having a frontage of a straight line of



127 miles. Its western boundary is the line of scarped
tren ding in a north-west direction from Wilson's Bluff; on
east by the edge of higher and undulating ground following
irre gular, but generally north-east line from the Head of
Big ht to a few miles west from Pidinga, lat. 30 deg. 10 m.
25 secs., long. 132 deg. 7 min. 1 sec., continuing thence, probabl
to Ooldea Water in lat. 30 deg. 20 min., long. 131 deg. 50 mi
31 secs. Its northern boundary is not known, but is probably
south of a line curving from Ooldea Water to Boundary Dam,
a few miles to the west of the meridian of Eucla, and in lat.
29 deg. 20 min.

The same geological features prevail throughout this region,
but differ from those of the country bordering it. Its other
natural features differ in different parts, though a general
uniformity prevails throughout.

I have adopted the name *Bunda* for the Plateau, that being
the native term for the sea-cliffs; a portion of the Plateau is
known as the Nullarbor Plain.

PREVIOUS EXPLORATIONS.

The Bunda Plateau is memorable in the annals of South Australian geographical research, by the privations which one of the bravest of her explorers, Edward John Eyre, suffered in traversing it. It has since then been crossed in an east and west direction and skirted by several travellers; and now since the erection of water-tanks at distances of about forty miles, rendered necessary by the work of maintaining the telegraph line in good order, a journey from the Head of the Bight to Eucla presents no difficulty.

FLINDERS.—The seaboard of the Bunda Plateau was surveyed from the sea by Flinders in 1802, and the appearance of its cliffs depicted by drawings and words, he stating that their elevation appeared to be from 400 to 600 feet.

EYRE.—In 1840 he undertook to explore the unknown country lying between this colony and West Australia. Streaky Bay was made the base of operations, and his attempt to round the Head of the Great Australian Bight was a fruitless one. On a second attempt he was driven back upon Fowler's Bay, after penetrating to within twelve miles of the Head of the Bight. From that place he started, January 2, 1841, on a third attempt, and succeeded in reaching the last of the sandhills, which intervene between the Head of the Bight and the commencement of the cliffs, called Bunda by the natives, from whence he penetrated forty-five miles along the cliffs, and then returned to Fowler's Bay. Nothing daunted, he essayed a fourth time, having previously reduced the strength of his party to his overseer Baxter and three blacks. Starting from Fowler's Bay, Febr-

25, 1841, he reached Keer-Kumban-Kauwe* on March 2. Setting off on the 7th, the journey across the Bunda Plateau to the sand-hills at Eucla was accomplished on the 11th, "and thus on the fifth day of our sufferings we were again blessed with an abundance of water." Thus a journey of about 140 miles was accomplished in five days, during which time no water was obtained, and the distress endured by men and animals was extreme.

In 1860 Major Warburton contrived to reach 85 miles beyond the Head of the Bight, and made several journeys from the coast in a north and north-west direction for a distance of about 60 miles. He found the district to the north to be a dreary waste, destitute of food and water. Rain seldom fell, and when it did was immediately absorbed by the arid soil. The above paragraph is quoted from "Forrest's Explorations," p. 77, but I do not know the source of his information.

Captain Delisser was employed in 1865-6 by this Government to survey certain lines within the district. His observations are affixed to the "Plan showing Surveys and Explorations by Mr. E. A. Delisser in the vicinity of the Great Bight and Fowler's Bay," published by the Survey Office in August, 1867. One line of traverse was from the Head of the Bight to 100 miles north from Eucla.

On the discovery of the roadstead off Eucla, Lieut. Douglas, President of the Marine Board, was entrusted with the duty of its survey. He, moreover, fixed the boundary line between the two colonies, which resulted in placing Eucla some five miles within West Australian territory, and Wilson's Bluff, the western termination of the Bunda Cliffs, less than one mile east of the 129th meridian—the boundary line.

In 1870 Mr. John Forrest headed an exploring party, which succeeded in traversing from Perth to Adelaide, around the Head of the Great Bight, nearly retracing the route of Eyre. From Eucla he made a flying trip northward, on the track of Delisser, but was unable to penetrate more than 27 miles, because of the absence of water. The country is described by him as open plains of grass, and that from the camp only plains were in sight; not a tree visible. He thus reiterates the observations of Delisser, which, however, extended many miles further. On the 14th of July Forrest's expedition started, carrying about thirty gallons of water. "After great privation," he writes, "to our horses, and not meeting with a drop of water for 185 miles, by travelling day and night we reached the Head of the Bight on the evening of the 17th." His route for the first 60 miles pretty nearly coincides with the telegraph line; thence he steered south of east and to the

*Written Coymbra in modern maps.

coast, which he followed to the Peelunibie sand patch at the Head of the Bight, where water was procured by digging in the sand.

His observations are the most meagre, but he describes the country as generally level, open, and grassy, and entirely destitute of water. He perpetuates, moreover, the error of Flinders respecting the height of Bunda Cliffs, and overlooks the partial correction given by Eyre.

Cornish surveyed a north and south line on the meridian of Ooldea Water, which passes through for many miles the eastern portion of the Bunda Plateau. His observations on the country have not been published.

Mr. Muir has lately travelled sheep from the Head of the Bight to Eucla, following pretty nearly the course of Delisser's surveyed line; but his actual route was determined by the position of the few rock holes which occur on either side, though not distant more than a few miles.

This region may be said to have been much travelled during the construction of the telegraph line, which traverses the Plateau at an average distance of ten miles from the coast, and follows Delisser's chief east-and-west line to within 45 miles from Eucla. By a fortunate circumstance it passes through the very best country.

In the latter part of 1878 Messrs. Fairlie and Woolley and a black started from Eucla in a N.N.E. direction in search of sheep country. The party not returning within a specified time, and one of their horses having come back, their Eucla friends, anxious for their safety, dispatched Messrs. Muir and Clark in search of them, who found Mr. Fairlie's dray at 80 miles out, but lack of water necessitated their return. However, a search party with camels was immediately sent out, and though the lost men were tracked to 100 miles out, and back to within three miles of their dray, neither men nor horses were found. No doubt of their sad fate is to be entertained, as the country has been graphically described to me by more than one of the searching parties, and briefly as a level stony desert, without water and trees, and the scantiest of vegetation. I exhibit to you memorials of this journey in the form of three species of fossils obtained at the last camp of the ill-fated explorers. They conclusively prove that the stony surface in this distant place is of the same nature as that of the top of the Bunda Cliffs.

Lastly, I was employed by the Government to examine the Bunda Plateau, with the view of forming an opinion as to the applicability of the artesian principle to obtain water. I was accompanied by Mr. Barron, trigonometrical surveyor, and John London, as general assistant, proceeding to Fowler's

Bay, which was reached on January 18th, 1879. Here the party was fully equipped, Richard Dorey joining to take charge of the seven camels which were our sole means of transport.

The route travelled is briefly sketched as follows :—

A start was made on the 24th, passing by Colona, Waltabie, to the sea coast at Coymbra, and reaching the Head of the Bight on the 30th.

On the 31st left Head of Bight, watering at Peelunibie, thence on to telegraph line as far as a deep well known as Roberts's, camping near two caverns at two miles north-west from the well.

Feb 1st.—Along telegraph line to Mallabie tank and rock hole, passing two other silent witnesses of the futile efforts to obtain water by deep wells.

Feb. 2nd and 3rd.—Travelled due north-west 33 miles from Mallabie.

Feb. 4th to 7th.—Thence to Eucla, with but slight deviations from a right line.

Feb. 8th.—Excursion along the escarpment of the Bunda Cliffs to the Mundundarra sand patch fifteen miles from Eucla.

Feb. 10th.—Excursion to Wilson's Bluff, eight miles from Eucla.

Feb. 11th to 16th.—Travelled along edge of Bunda Cliffs to 90 miles from Wilson's Bluff, thence inland to Mallabie tank.

Feb. 17th and 18th.—From Mallabie to termination of the Bunda Cliffs, thence round western edge of the Peelunibie sand patch to the Bight sheep station.

Feb. 19th.—Excursion around the shore of the Head of the Bight to the sand-rock cliffs on its western side.

Feb. 20th to 23rd.—To Pidinga rock basin, excavated in metamorphic rocks, flanking on the east a granitic boss; bears about north-west from the Head of the Bight, distant 72 miles.

Feb. 25 to 27.—Pidinga to Colona, inspecting five wells recently sunk by the Government, and thence to Yalata, Fowler's Bay.

At this date so little time remained at my disposal, that not only was further exploration impossible, but all expedition had to be used to enable me to reach Adelaide on March 11th, but in spite of our most strenuous efforts the metropolis was not regained till the 17th.

The interval between our first departure from and return to Yalata, Fowler's Bay, was 34 days, during which time our camels had accomplished a journey of 566 miles in 29 travelling days, or an average of 19·5 miles per day.

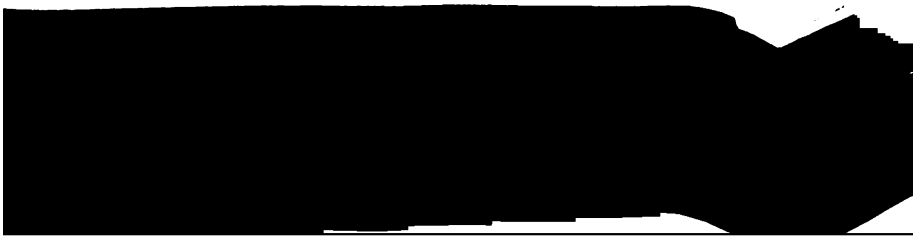
My experiences of camels and camel-riding are not of a

pleasant nature, and the physical and mental relief on gaining Yalata, where the camels were dispensed with, was of the most refreshening kind. From that place a ride of 200 miles on horseback brought us to Streaky Bay, but the journey was broken for a day at Pinong to permit me to visit Lake MacDonnell. From Streaky Bay the rest of the overland journey was done in a mail car; Port Lincoln was reached on March 14th, and there ended my travels by land of about 1,000 miles occupying seven weeks.

The length of time occupied in each day's journey, and the mode of travel, rendered collecting an almost impossible task; the opportunities for doing so were after each day's travel, when usually less than an hour of daylight remained to me, and the few occasions on which a lengthier halt than usual was made. The routine—Up at 4.30 a.m., start at 6, noonday halt for lunch, travel to 3.30 or 4 p.m., whilst dinner and preparing for the night invariably occupied us till after 5 p.m.—was forced on us because of the limited time at my disposal, and the absolute necessity there was of making rapid progress from one watering place to another. Of the 34 days occupied in the survey out from and into Fowler's Bay, only for five days were the camels in camp, but these were not days of enforced idleness for me, as an average of thirteen miles travel per day was done in visiting geological sections.

Form of the Ground of the Bunda Plateau.

The Bunda cliffs constitute the sea margin of an approximately level plateau, the elevation of which at their eastern termination is 155 feet, but which gradually increases to 250 feet at Wilson's Bluff on the west, rising thence inland to 290 feet at the summit level of the dray road to Eucla. The first 45 miles from the Peelunibie sandhills, the coast cliffs are crowned with loose sand, which forms a raised lip on the margin of the plateau; with the increasing height of the cliffs, the sand becomes less in amount and discontinuous, and is finally seen in dome-like patches, trailing away to the north-west. But for these interruptions, the whole surface along the cliff edge is almost level, showing only a slightly flowing outline. In these particulars I am in accord with Mr. Eyre, who writes "there was no perceptible inclination of the country in any direction, the level land ran to the very borders of the sea, where it abruptly terminated, forming steep and precipitous cliffs" (I. p. 324), and "to the westward we found the country rising as we advanced, and the cliffs becoming higher" (p. 325). The height of the cliffs is stated by Flinders (I. p. 96) "to be nearly the same throughout, being nowhere less by estimation than 400, nor anywhere more than 600 feet." Eyre gives the general elevation at from three to four hundred feet (p. 324.)



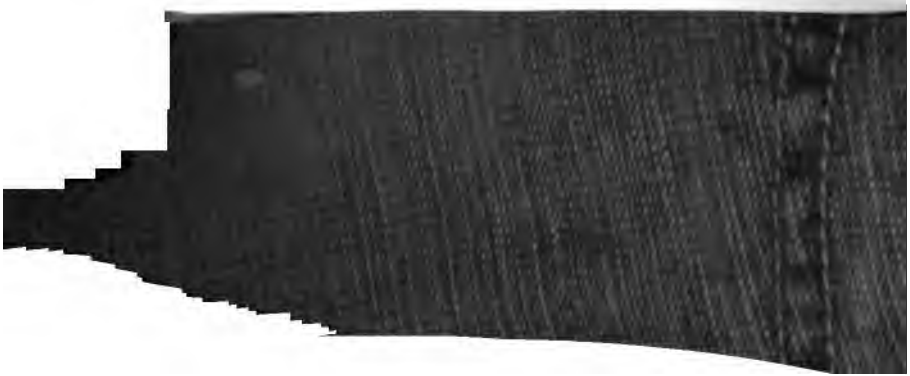
My determinations of the height of Wilson's Bluff and the summit of the Eucla Road are from aneroid data compared with the barometric readings taken at the Eucla Telegraph Station. The various heights along the cliff edge were obtained by measure, and are as follows:—

East end of Bunda Cliffs	145 feet.	
87 miles west from above	152 feet,	general level.
	162 "	to crown of sand ridge.
70 miles east from Wilson's Bluff	200 "	general level.
	235 "	to crown of sand dome.
25 miles east from Wilson's Bluff	225 feet.	
Wilson's Bluff ...	250 feet (by aneroid).	

Passing inland from the coast a change of level is perceptible in the form of long synclinal curves and short ridges, but in no determinate direction; and they do not appear to result from undulation of the rocky substratum. For the most part the differences of level between the dips and rises do not exceed ten feet. Where the bed rock is concealed the ridges are crowned with travertine, or travertine rubble, of at least from two to three feet thick; whilst the depressions are occupied with a light loam up to eight and ten feet in depth.

An impression still prevails that the surface of the country declines from the edge of the sea-cliffs, and that the far interior is at or below sea level—a notion that may have been fostered from the fact that not a single watercourse breaks the prevailing uniformity of the surface of the seaward margin of the Plateau. This notion is traceable to Flinders, who, when writing of the Bunda cliffs, says that "the bank may even be a barrier between the interior and the exterior sea, and much do I regret the not having formed an idea of this probability at the time" (I., p. 97). And though Eyre pointed out the incompatability of the existence in the interior of an extensive area of water and the occurrence of excessively hot and dry winds blowing from the same quarter,* yet he has unwittingly given support to the fallacy by a statement made on p. 285, vol. I., and repeated on p. 323, to the effect that the whole of

* "The weather was most intensely hot, a strong wind blowing from the north-east, throwing upon us an oppressive and scorching current of heated air, like the hot blast of a furnace. There was no misunderstanding the nature of the country from which such a wind came. Had anything been wanting to confirm my previous opinion of the arid and desert character of the great mass of the interior of Australia, this wind would have been quite sufficient for that purpose. From those who differ from me in opinion I would ask, Could such a wind be wafted over an inland sea? or could it have passed over the supposed high and perhaps snow-capped mountains of the interior" (I., p. 273).



this level region was completely coated with small freshwater spiral shells of two different kinds. The shells referred to are exclusively terrestrial in habit, and may be found living in the midst of their progenitors.

To illustrate the steady gradient which the land surface presents in a northerly direction, I have constructed a horizontal section from Mallabie to the coast, bearing five degrees west of south-west (true), and in length thirteen miles; also another from the same place bearing true north-west for thirty-three miles. The inland station is thirty-one miles due north from the coast. The aneroid observations between the coast and Mallabie were taken on a journey occupying three and a half hours, and corrected give the elevation of Mallabie at 247 feet above sea level (or 85 feet above sand-lip), or 95 feet above the general level of cliff, corresponding to a rise of seven and four-thirteenths feet per mile; but referred to a datum line striking the coast at its nearest point the grade is ten and five-ninths feet per mile.

The aneroid readings on the traverse north-west from Mallabie are not very reliable, as the barometric disturbances on the second and following days out were very great; nevertheless, they give a gradient in a direct line from the coast of nine feet per mile; the elevation of the interior station being 460 feet above sea level.

Another traverse from the head of the Bight to Pidinga shows much the same surface features, excepting that all the higher parts of the undulating ground are composed of loose sand—being the fringes of the sandy and scrubby rises which bound the Plateau on the east.

The united testimony of those who have penetrated some miles beyond the coast, and applies to the country included within the meridians of Eucla and Ooldea water for a distance of 100 miles, is that the Bunda Plateau is level, treeless, and devoid of stream courses. The opinions touching the aridity of the country are not so unanimous, but the extreme opinions have doubtlessly been formed from observations made at the most and least favourable conditions for vegetable growth. The same explorer would report very differently as to the aspect of the vegetation immediately after copious rains, and after successive seasons of drought, which most observers seem agreed as characteristic of the Bunda Plateau.

In the treeless region the traveller has ever around him an *ignis fatuus* in the form of distant hills clothed with lofty pines. So uniformly level is the surface that his view does not extend beyond a radius of four miles. The hills are, of course, never reached, but the pines dwindle in size as they are approached, and the eye, now no longer deceived by atmospheric

refraction, discovers a thicket of broom of about one foot and a half high.

With the exception of the scored face of the escarpment of the Bunda cliffs about Wilson's Bluff, and that around the Pidinga rock basin, the whole region shows no traces of flowing water. Not only is this so for the Bunda Plateau, but is equally true for the whole coast line to near Port Lincoln.

Geology of the Bunda Plateau.

Introduction.—Since the time when Eyre described the Bunda cliffs as being composed for the most part of white chalk with layers of flints, the interest of geologists has ever been active to know if the rock be a true chalk.

Capt. Flinders conjectured "the evidently calcareous nature of the bank" to be the exterior line of some vast *coral* reef, and broached the daring theory that its present elevation arises from the gradual subsiding of the sea, or perhaps from some convulsion of nature.

Eyre confirms the description of Flinders, and gives a detailed and accurate account of the stratification of the cliffs, estimating their height at 300 to 400 feet.

Sturt, in alluding to Flinders' opinion, says:—"The only point we differ upon is as to the probable origin af the great sea-wall. Had Capt. Flinders been able to examine the rock formations he would have found that it was for the most part an oolitic limestone with many shells embedded in it, similar in structure and formation to the fossil beds of the Murray, but differing in colour." All this is a contradiction of Flinders and Eyre, and a misrepresentation of observations made by the latter, who describes the upper surface of the country to consist of a calcareous oolitic limestone, below which is a hard concrete substance of sand and soil mixed with shells and pebbles. Below this again the principal portion of the cliff consisted of a very hard and coarse grey limestone, and below it a gritty chalk.

Eyre is, however, wrong in describing the superficial rock as an oolitic limestone, and Sturt is equally inaccurate in comparing it with the prevailing stone in the Murray cliffs. "Upon what data Captain Sturt made such statements he does not tell us, but it may be here noticed that he thought the beds were continuous with those he observed inland, that is, on the banks of Lake Torrens."—Woods' Geol. Observations in S. A., p. 117.

This guess of Sturt's, which proves to be not far from the truth, seems to have been adopted by subsequent authors, as the Rev. J. E. T. Woods classifies the rocks of this country among the older tertiaries, and Mr. R. Brough Smyth has

coloured the area as tertiary in his sketch map of the Geology of Australia. Mr. Woods has more recently sought to bring the fossiliferous formation of the great Australian Bight into closer correlation with the Mount Gambier beds rather than with those of the River Murray.—(Trans. Roy. Soc., N.S.W., 1877.)

A view not accepted by the Rev. W. B. Clarke, who writes—"But somehow the great sections along the Australian Bight have yet to be catechised as to whether the Australian tertiaries follow the laws which rule the existence of these deposits in Europe, or whether the peculiar aberrations noticed by Mr. Woods in some of his valuable writings are or are not exceptions to those laws."—(Sedimentary Formations of N.S.W., 1878, p. 95.)

Aware of the great interest that had thus grown up respecting the cliffs of the Australian Bight, I naturally allowed the desire to scientifically examine them to influence me in undertaking the commission, which seems likely to prove an arduous one, and one not without risk, offered me by the Government. But one of the greatest disappointments which it has been my illfortune to experience as a geologist was in reserve for me, as I travelled along the whole line of the Bunda cliffs without having been able to make a close inspection of them, because with the sole exception of the west face of Wilson's Bluff they are inaccessible. My first acquaintance with the Bunda cliffs was made at Wilson's Bluff, and unaware of their inaccessibility throughout their range I did not repeat my visit, which I otherwise would have done; and as my chief occupation on that occasion was the construction of a stratigraphical section —a very difficult and dangerous task, by the way—I bring back with me a very meagre collection of their fossils; but these, I think, will prove sufficient to establish a correlation with other tertiary formations in this colony.

Range of Older Tertiary Escarpment.—The Bunda tableland is the elevated bed of the Older Tertiary sea, whose sediments were deposited within a very extensive granite basin. Eyre's Peninsula is granitic and metamorphic, the only tertiary strata on it being a fringe of pleistocene on the south coast; similarly constituted is the south-west part of Western Australia, whilst between these great protuberances lie the older tertiary. The edges of the granite base are seen on the east at Yalata, Fowler's Bay, at Pidinga, and Ooldea; on the north at Boundary Dam, and on the west at Point Culver. Between the extremes on the coast—Point Culver, lat. 125 deg. 30 min., and near Fowler's Bay in about lat. 132—the older tertiary rocks follow a gentle curve, the chord of which is about 500 miles in length, and extend seaward for at least eight to fifteen

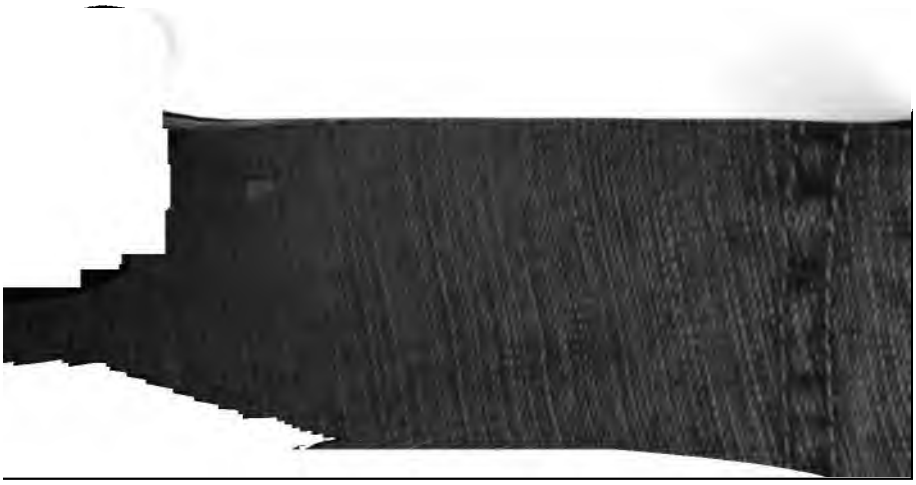
miles from the shore at the head of the Bight, where the depth of water, according to D'Entrecasteaux and Flinders, is from 27 to 30 fathoms. Beyond the base of this tertiary platform a great depression was observed by the late Capt. Owen Stanley, in the Rattlesnake.

For some miles to the west from Fowler's Bay the margin of the older tertiary is for the most part obscured by newer beds, but near Coymbra it forms an escarpment which is traceable around the sandhills at the head of the Bight, and beneath the sand drifts at Peelunibie to where it forms the commencement of the Bunda cliffs. The cliffs hence present a precipitous front to the sea without a beach at the base to within sixteen miles from Wilson's Bluff, thence to that headland a steep slope of consolidated blown sand masks their face. The Bunda Cliffs have a nearly straight trend with a general bearing of west 5 deg. south, but at Wilson's Bluff they curve a little to the north and continue as a bold inland escarpment, called the Hampton Range, having a direction nearly parallel with that of the sea cliffs, curving southward in lat. 127 deg., and reach the sea at fifteen miles to the west of Eyre's Patch or 180 miles from Wilson's Bluff; thence to Point Culver, a distance of 100 miles, the edge of the older tertiary plateau presents a perpendicular front to the sea similar to that of the Bunda.

The whole country between the scarped front of the Hampton Range and the sea is a sandy plain, "Roe's Plains," encumbered with *debris* from the cliffs, and the sea margin with hills of blown sand. The width of this plain varies, as the coast line does not conform with the trend of the escarpment. At Knowsley, 24 miles from Eucla, it is 10 miles; at Mandrabiela, 61 do., 20; at 110 miles from Eucla, 22; at Eyre's Patch, 160 miles from Eucla, 5.

Geological Sections of Older Tertiary constituting the Bunda Plateau.—Flinders described the upper one-third part of the cliffs as brown and the lower two-thirds as white, and that the upper brown stratum augmented in proportional quantity as he advanced to the east. Eyre added very little to this brief account in his description of the structure of Wilson's Bluff; he, however, notes the lithological characters of the two bands, and the presence of shells in the upper stratum and of flints in the lower "gritty chalk."

My principal section is that of Wilson's Bluff, which is subjoined, but as an apologetical introduction I may apply to myself the words of Eyre—"Being now at a part of the cliffs where they receded from the sea, and where they had at last become accessible. . . . the part I selected was high, steep, and bluff towards the sea, which washed its base. By crawling and scrambling among the crags I managed, at some risk, to get



at these singular cliffs. I felt quite a relief when my examination was completed, and I got away from so dangerous a post." (loc. cit., I. p. 338.)

SECTION OF WILSON'S BLUFF.

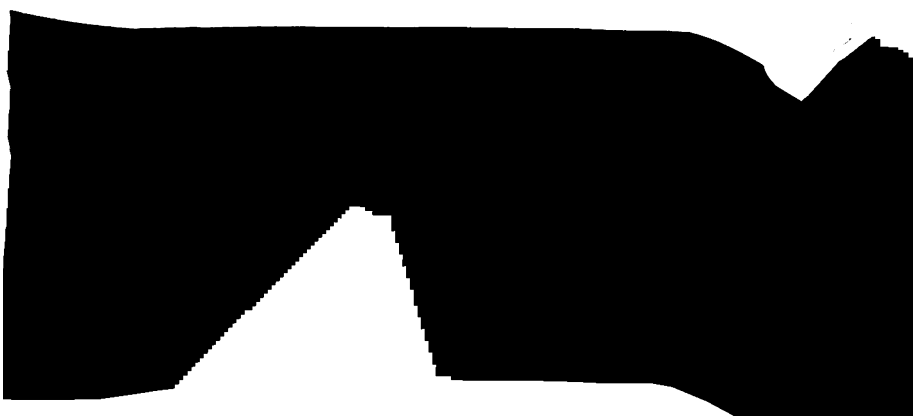
[See pl. iv., fig. 8.]

	Thickness. Feet.	Inches.
I. Grey to brown crystalline limestone, cast of shells	50	0
II. Yellow friable polyzoal limestone	12	0
III. *a*. Hard white limestone full of palliobranchs ..	2	0
b. Unseen	56	8
b. Rough chalk rock	9	8
c. Layer of Gryphæa, &c.		
d. As *b*	49	8
e. Irregular layer of flint		
f. White chalk	30	0
g. Flint layer		
h. White chalk	40	0
Total	250	0

Comparative sections made at various points along the cliffs bear out the general observations of Flinders and Eyre respecting the attenuation of the chalky stratum from west to east.

Succession of strata.	Wilson's Bluff.	Thickness at Stations east from Wilson's Bluff.			
		28 miles.	71 miles.	90 miles.	129 miles cliff end, Head of Bight.
Superficial deposits of sand and travertine		5	40	35	10
Crystalline limestone ..	50	92	40	49 8′	35
Friable polyzoal rock ..	12		100	42	80
Chalk	188	128	60	25	20
Total	250	225	255	151 8	145
Total thickness of older tertiary	250	220	200	117	185

As the several strata were recognised only by colour and appearances produced by weathering, it is probable that the thicknesses given to each stratum may not be absolutely correct, though the thicknesses assigned were determined by measure. Accepting the above data, the crystalline limestone seems to have suffered very little from denudation, or rather, it may be, that disintegration has been equally distributed. Its base shows a fall of 100 feet in a distance of 129 miles, whilst the chalk shows in the same distance a



diminution of 168 feet, from which circumstance I am of opinion that the intermediate rock of the eastern sections is coterminous with the chalk rock of the western ones; both rocks are made up of the same material, though differing in colour and amount and degree of fineness of the earthy constituent. In other words, they have been derived from the one source; but the distribution of the debris has been regulated in accordance with its different degrees of fineness and distance of transport. The white chalky rock occupies the deeper parts of the granite basin; whereas the shore deposits are sands and crystallised limestones, as is proved by the sections about Pidinga. (See below.)

The Crystalline Limestone is for the most part fine grained, and varies in colour from white to grey, brown, and pinkish. It is brown on the Bunda cliffs, but on the escarpment of the Hampden Range it is externally hoary, which produces a pleasing contrast with the dark foliage of the scrub clothing the slopes through which the white surface of the rock glimmers. As seen on the coast this band is deeply fissured and cavernous, and is further divided by joints, which cause it to separate into huge cubical blocks.

It occupies the topmost position of the Older Tertiaries throughout the whole extent of the Bunda cliffs, and it crowns the escarpment of the Hampton Range; it is seen in the same position in the wells and caverns between the Bight and Mallabie, and, so far as is known, makes the surface of the ground over the whole arid portion of the Bunda Plateau; indeed, it is mainly to this circumstance that the Plateau owes its peculiar characters. It abuts against, and occupies the depressions in, the granite and metamorphic rocks about Pidinga; where, resting on gneiss, its base is conglomeratic, but where mica slate is the underlying rock a clay intervenes. A section showing the junction of the latter is as follows, taken at the low escarpment bounding the Pidinga rock basin, at about half a mile south of the Talacoutra rock hole. (See horizontal section, pl. iv., fig 1.)

	feet.
Whitish yellow shelly limestone, with cast of fossils...	3
Yellow clay...	5
Red and purplish clay, decomposed mica slate, *in situ*	5

At distances varying from 18 to 28 miles north from Colona towards Pidinga, three wells have been sunk in older Tertiary limestone interspersed with sand. The section in the one 18 miles from Colona is as follows:—

Surface soil	...	...	...	2
Limestone	...	...	...	1
Sand ...	...	...	...	4
Limestone	...	...	...	2
Sand ...	...	...	...	18
Limestone	...	...	...	33
Yellow sand	...	...	...	102
				162

The limestones are grey to pink, of a highly crystalline texture, and fossiliferous, and of the same general character as the top limestone of the Bunda Cliffs, excepting that some of the limestone debris contains quartz grains. The bottom sand is a sharp yellow to grey quartzose detritus; near proximity of granite rocks is to be inferred.

The crystalline limestone, wherever examined, was found to be fossiliferous; but as the fossils were all in the state of casts I paid very little attention to them, feeling that their specific determination would be accepted with distrust. *Voluta*, *Cypraea*, and *Chione* are common, and I have ventured to attach specific names to a few very familiar forms—*Cassis subfimbriatus*, *Trigonia acuticosta*, and *Placotrochus deltoideus*.

The whole aspect of the stratum points to a correlationship with the upper limestones forming the Aldinga series, and particularly with the uppermost stratum of the older Tertiary about Wallaroo.

Mr. J. Clark, Telegraph-master at Eucla, has presented to me a few fossils and stones picked up by him on the surface at Fairlie's last camp, 80 miles N.N.E. from Eucla. The fossils are undoubtedly older Tertiary, and though their tests are chalcedonized and deeply stained with oxide of iron, yet as the matrix is a yellow crystalline limestone, I would refer them to the horizon of the upper bed of the Bunda cliffs. One species, the *Cerithium*, is not uncommon in the Turritella-marls of the Lower Aldinga series, but the corals are new to the colony. The species are :—*Cerithium nullaboricum*, Tate; *Plesiastræa*, sp.; *Seriatopora*, sp. (one of the commonest of the reef-building genera in North Australian waters).

The Yellow Polyzoal Bed.—Fallen blocks of marble have attached to them a yellow friable rock consisting for the most part of polyzoal debris, bearing a close resemblance to the main mass of the cliff on the Murray at Mannum, and to some of the lower beds on the west side of St. Vincent's Gulf. It leaves a small quantity of a reddish aluminous residue after solution in acid. The thickness of this band at Wilson's Bluff is twelve feet, its upper surface increasing in compactness, and finally graduates into the overlying marble; its junction with

the underlying stratum is abrupt. The only recorded fossils are *Echinus Woodsi* and *Cellepora hemisphærica*.

Eastward from Wilson's Bluff it increases in thickness, and at the termination of the cliffs has an estimated thickness of eighty feet, the overlying marble being thirty.

The same band was passed through in the wells, and is exposed in the caverns about Mallabie, in the latter under a cover of thirty feet by estimate of marble; as also in a cavern twenty-one and a half miles north-north-west from Mallabie, where *Pecten Gambieriensis* was noted.

White Polyzoal Limestone.—This, the *piéce de resistance* of the geology of the Bunda Plateau, has a thickness of 188 feet at Wilson's Bluff, where it attains its highest known altitude above sea level. It is a white friable earthy limestone, coarser and harder than chalk, and readily dissolving in acid, without leaving any appreciable residue. On a cursory inspection one is struck by its similarity to the chalk of England, heightened by the presence of layers of black flints and fossils, with a cretaceous facies such as *Salenia*, *Cidaris*, *Gryphæa*, like *G. vesiculosa*, a *Terebratula*, barely distinguishable from *T. carnea*, *Terebratulina*, &c., &c.

In its origin it differs as the debris has been derived from polyzoa; foraminifera, though present, are not abundant.

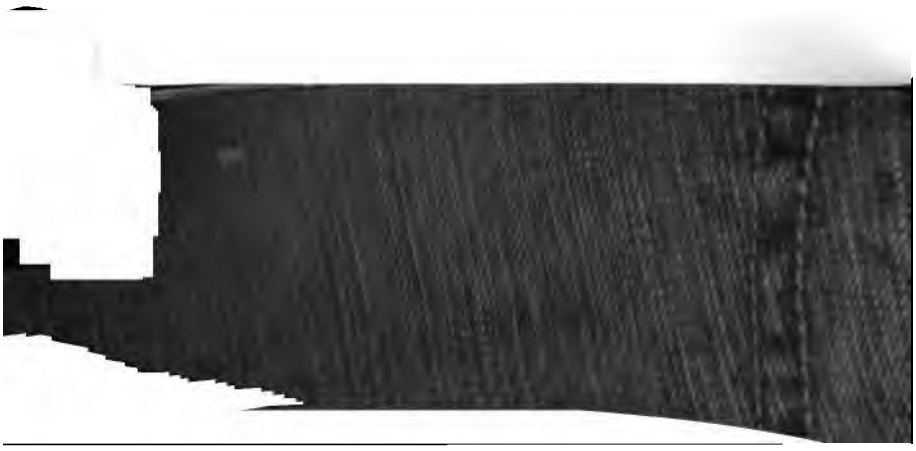
The section at Wilson's Bluff exhibits the position of the flint layers and fossil bands. The upper part is a hard white stone, ringing under the hammer, full of *Waldheimia*, stained with glauconite, and does not graduate into the overlying limestone. From Wilson's Bluff to the east this band declines at the rate of 1·32 feet per mile, and at the Peelunibie end is only twenty feet thick, by estimate, above sea level. About due north it was reached in a well, 162 feet deep, but the depth penetrated is not known. In no other inland locality is it within view.

This same horizon seems to be the one reached in the wells to the eastward of the Bight, but has there* acquired much silicious property.

The fossils obtained at Wilson's Bluff, all *in situ*, are given in the following table:—

Name of Species.	Occurrence Elsewhere.
Gryphæa tarda? Hutton.	Lower Aldinga series, Aldinga. Upper Eocene, New Zealand.
Plicatula sigillata, Tate.	Lower Aldinga series, Aldinga; Yorke's Peninsula. Lower Murravian, Mannum.
Lima armigera, Tate.	
Pecten Eyrei, Tate.	Lower Aldinga series, Aldinga; Yorke's Peninsula.

*An analysis gave a grey pulverulent insoluble residue of 10·64 per cent.



Terebratula subcarnea, Tate.	
Waldheimia insoluta, Tate.	Lower Aldinga series.
	Upper Eocene, New Zealand.
Terebratulina triangularis, Tate.	Lower Aldinga series.
Retepora sp.	Lower Aldinga series.
	L. & M. Murravian, River Murray; Mount Gambier.
Cidaris Australiæ, Duncan.	Throughout Older Tertiary, *passim*.
Salenia tertiaria, Tate.	Lower Aldinga.
Echinus Woodsi, Laube.	Lower Aldinga; L. & M. Murravian.
Eupatagus coranguinum, Tate.	Lower Aldinga.

CORRELATION.—Of the total of twelve species in the chalky rock, ten are well known forms in the lowest Tertiary strata on the shores of St. Vincent's Gulf, which, as I have stated elsewhere (Proc. Phil. Soc. Adelaide, 1878, p. 122), should be placed at a lower horizon than the Lower Murravian. The only other exposure of rock at all resembling the white limestone of the Bunda cliffs is that occupying the shore of MacDonnell Bay, between the township and Cape Northumberland, which also contains flint layers and erect Paramoudra-like masses of flint, comparable in size and shape with those of Antrim, though they exhibit occasionally a somewhat aborescent form, foreign to the Irish specimens. I have no fossils from the MacDonnell Bay stratum. But passing inland, we find at Mount Gambier white, rather granular, limestone, coarser in texture, but containing flint layers. The Mount Gambier bed contains a good many of the fossils characteristic of the Lower Aldinga series, whilst a higher horizon seems to be attained in the yellow polyzoal rock of the Mosquito Plains at Narracoorte. Indeed, the sequence of deposits as determined by fossils and lithological characters would appear to be the same in the south-east as in the Bunda Plateau, excepting that the crystalline limestone of the latter does not exist in the former area.

The Rev. J. E. T. Woods says that "all fossils I have seen from these beds [of the Australian Bight] have been familiar forms from Victorian or South Australian beds. I should imagine, from the description of the beds themselves and the fossils submitted to me that they were nearer to the Mount Gambier formation than those of the River Murray." (Trans. R. S., N.S.W., 1877.)* So far we are in accord, but we are not agreed as to the relative position of the Mount Gambier beds. In 1865 he referred them to the Older Pliocene, placing the Murray beds as Upper Miocene (*vide* Phil. Soc., Adelaide,

* Mr. Woods, in a letter dated August, 1879, writes:—"The fossils I saw from the Bight were entirely like those of the Murray Cliffs in character—a yellowish limestone, and the fossils mostly in casts. I recognised in them a few Mount Gambier forms." His remarks, therefore, apply only to the top limestone of the Bunda Plateau.

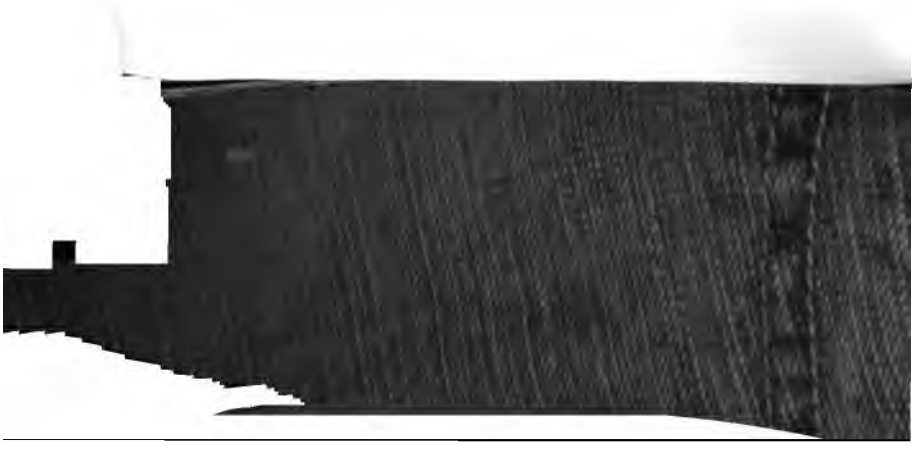
1865); and in 1877, in a letter to me, he writes:—"I am surprised, pleased, to find that the Muddy Creek beds are above the Murray Cliffs; but what surprised me most is that you regard the Mount Gambier beds as lower than either. This I certainly did not expect, though I admit I had no good reasons for my opinion."

Neglecting the lower half of the chalk rock of the section at Wilson's Bluff, as from it I only gathered one fossil *(Lima armigera)*, I find that the *tout ensemble* of the Bunda cliff and Blanche Point cliff, Aldinga, to be the same. I cannot deny that my opinion is not well supported by palæontological observations, and that the lithological characters seem to be widely different. Respecting the latter, it is after all more apparent than real, and the Aldinga section, in some of its details, closely resembles that which exists on a grander scale in the Bunda cliffs. The band in which *Salenia* and *W. insoluta* occur is at Aldinga a white limestone, with glauconitic grains; and the bed under the top limestone is at many places as highly charged with polyzoal debris as the middle band in the Bunda cliffs. I must declaim against my opinion touching the correlation of the older Tertiary of the Bunda cliffs as being a mere guess. It is certainly something more than what is vaguely called an impression, for I have some basis for my opinion, which is corroborated by that kind of intuitive perception of the relation of things which comes from frequent contact with the object of study in all the varying phases which it presents.

For these and the explicable reasons which I have stated I see in the Bunda cliffs a stereotype of the Aldinga section, with only a slightly different coloration.

Minor Features.—The crystalline limestone is not a rock absorbent to water, as may be inferred from the fact that all the rock-water holes are in it; but because of the many joints and fissures which vertically penetrate its whole thickness, the rain which falls on its surface is immediately lost to view, and sinking through the yellow polyzoal bed, is somewhat detained or directed to the front of the cliffs by the band of hard chalk.

Around Wilson's Bluff, where the yellow polyzoal bed is thin, and the top of the chalk high up in the cliffs, it is only the crystalline limestone that presents a perpendicular face, whilst the long slope of chalk is encumbered with the blocks of the upper bed set free by their weight pressing down on the moistened surface of the chalk. This action has originated the gulleys or steep-sided ravines which indent the escarpment of the Hampton Range and the western 26 miles of the Bunda cliffs. They do not penetrate beyond a few hundred yards



from the front of escarpment, or, in the case of the Bunda cliffs, a few hundred feet.

Further east along the Bunda cliffs the top bed and its underlying polyzoal limestone is perpendicular, or even overhanging, that part of the chalk within the influence of the ocean swell being hollowed out. By the combined action of percolating water from above and the sea waves below great masses of the upper part of cliff are seen at short intervals forming protecting buttresses to jutting points. The front of the seawall is washed in all states of the tide, and follows a curved line, the chords of which are about eight to ten miles long, with subordinate serrations. On looking forward or backward, as the case may be, one serration is seen projecting beyond the one preceding it to the end of the long curve. Each projection has a talus as remarked above, and the indent between each is in length five or more hundred yards, but with a long curve towards the east, and the shorter one directed towards the west.

This general appearance of the coast cliffs is modified at places by the occurrence of slides of greater magnitude than ordinarily. The first effects of the movement of the upper beds on the chalk is visible on the surface in the form of long crevasses parallel to the edge of the cliff, and at distances from it of a few to many yards.

The caverns, which are many on the Bunda Plateau, are excavated in the crystalline limestone, and extend down into the underlying friable band. Their presence is indicated on the surface by crateriform depressions, in the centre of which is the perpendicular aperture to roomy excavations, the roof of which in many places rises nearly to the surface in the form of inverted pot-holes. Though slight signs of waterflow from the edge of the depression to the aperture are visible, yet in the interior there is no indications of percolating water. The earlier stages of the formation of the cavern are those perpendicular vents called blow-holes, up which there rushes on hot days a violent wind, which may also be heard coursing along the lateral passages with the sound of a mill-race. From the known widely-fissured and cavernous character of the crystalline limestone as seen on the coast, there can be little doubt that the stratum throughout its whole extent presents continuous air passages. The air in the passages and caverns in the interior part of the plateau acquires a higher temperature during the day than that on the face of the sea cliffs, in consequence of which an indraught is caused towards the hotter region. On one occasion I compared the temperature of the air as it flowed from a blow-hole with that in the shade of a tree. The shade temperature was 78 deg., and the same ther-

mometer suspended two feet within the blow-hole registered, after the lapse of three minutes, 70 degs.

The post-miocene rocks of the Bunda Plateau are comparatively so insignificant, and because they form part of a series which elsewhere assume considerable proportions, I will include them in my general account of that group of strata.

The Newer Tertiaries around the Head of the Great Australian Bight.

Between the Head of the Bight and Fowler's Bay the surface is occupied with loamy and grassed flats alternating with sandy ridges covered with mallee. The grass flats are margined with spurs and terraces thickly covered with travertine. Wells have been sunk on the travertine, and the older tertiaries passed through to depths up to 180 feet or more, water being always met with in a grey silicious limestone, which may be coterminous with the chalky rock of the Bunda cliffs. The water is more or less brackish, but for the most part the quantity and quality increases towards the coast.

The sand, which crowns all the higher ground inland, is probably derived from the waste of the granitic and quartzitic rocks to the north. Though the period of its formation is uncertain, yet I venture to suggest that it is of fluviatile origin, and is coterminous with the plant-bearing sandstones of Ardnamukka, on the west side of Lake Torrens.

Excepting the Bunda cliffs, the whole coast line of the south-western part of this colony is constituted of post-miocene rocks. The prevailing subter-structure of the country between Eucla and Fowler's Bay is that of the older tertiary limestone, and between the latter place and Port Lincoln it is that of metamorphic rock, chiefly mica-schist, through which protrude granitic masses, overlain by derivative material, and flanked on the seaboard by more or less consolidated calciferous sands. The latter section of the country is represented on Brough Smyth's geological map of Australia as occupied with tertiary strata, but as I have shown (ante p. 103), the older tertiary of this western country occupies a well-defined basin, and is not coterminous with that of any other part of the province. Most of the trigonometrical stations and the higher elevations eastward from Fowler's Bay are granitic.

Eastward from the Head of the Bight, the whole coast line is flanked by sand dunes, generally based upon a false-bedded consolidated sand ; which, however, occasionally attains a moderate elevation above sea level. All the bluffs are composed of the consolidated sand, and by its oblique lamination and rapid decay of portions, there result those fantastic and picturesque rock faces, needles, and scars which contribute so

Plate 4.

Fig. 1

N.E

S.W

Pidinga tank station

recent tertiary

older tertiary

mica slate & gneiss

granite

quartz lode.

older tertiary

Fig. 2.

Loam sand

Travertine

Sand-rock

Gray sand-rock with land shells.

Breccia

Red sand rock

Sea

Fig. 3.

Sea

R. Tate, del.

SURVEYOR GENERAL'S OFFICE, ADELAIDE. Fraser S. Crawford, Photo-lithographer.

much to relieve the prevailing monotony characteristic of tl coast.

These æolian rocks extend several miles inland at vario places, and from the large amount of calcareous matter whi they contain there has been formed by its solution and transpiration towards the surface, and precipitation there limestone crust or a stratum of consolidated sand. For t most part this crust occupies the present surface, and may best studied about Streaky Bay and thence to Bramfield. E other layers are frequently visible, which have doubtlessly be formed under similar conditions, and which mark older s faces. The sands and consolidated beds contain land shel which are often met with imbedded at great depths below t surface. The following section on the coast near Fowle Point illustrates the leading characteristics of these aer deposits:—

F

Loose sand, white in colour, rising to considerable elevation in from the edge of the cliff.

Travertine and limestone breccia in rude courses, overhanging ... ...

Sand layer mixed with lumps of travertine and blackened angular fragments of limestone, presenting a very scoriaceous appearance; land shells in abundance ...

Sand rock: consolidated coarse yellow-red sand in thick wedged-shaped courses; weathering into stalactitic or columnar-like form on the face, and also honeycombed

At Fowler's Bay the travertine band comes down to the level, where it forms reefs, and the whole cliff seems to made up of shifting sand. Similarly it falls to sea leve Fowler's Point, leading one to infer that a sandbank become elevated, then had acquired its calcareous crust, and later times become buried by blown sand.

The sand dunes have in many places barred extensive b and creeks, such as Lakes Hamilton and MacDonnell; wh in other instances have been subsequently silted up, and elevatory movements are now shallow salt pans or lago such as the Yalata and Peelunibie Swamps.

The Yalata Swamp is not more than two feet above h water mark, it is an extensive basin, occupied with yellow white clayey sand. Around its margin is a loose shell ss surmounted by a white shell-limestone full of bivalves v valves in apposition. The general level of the top of the rec marine bed above the swamp is four feet; or six feet ab high water mark. A more recent deposit in the form of a sl of travertine of about six to nine inches thick at the great

spreads over the shell limestone and the shell sand, and has enclosed the shells of the latter.

As elsewhere in the colony, these recent marine-beds contain the usual assemblage of shallow water forms of the present coast line, but in addition are characterised by the abundance of individuals of a few species either very rare or extinct in our waters. In the Yalata deposits, the most notable are *Arca trapezia*, *Cryptodon ovulum*, *Dentalium Tasmanensis*, and *Columbella australis*. The sand drift inside the dunes of the "Roe Plains" at Eucla rests on a calciferous sandstone, containing the common shells of the present coast. The shells of the Mactræ and other bivalves, being in apposition, prove that the fossils lived and died on the spots where now found. The highest elevation at which these evidences of recent oscillation of level were seen is at about twelve feet above high water.

As previously stated (p. 104), the Bunda cliffs are at their extremities fronted by an undercliff of consolidated blown sands, which belong to the series of æolian deposits just described. Plate iv., fig. 2 exhibits the manner in which they have been accumulated in front of the sea wall, have acquired some debris from the cliffs, and have streamed over upon the crown of the escarpment; the truncated seaward face of the undercliff is characteristic not only here, but of other parts of the coast line. That the sands, which form the knolls on the seaward edge of the Bunda Plateau referred to at p. 99 have been blown up from the shore is indicated by their mode of occurrence, and by the nature of the material, which I find to consist of rounded grains of limestone dissolving freely in acid and leaving an aluminous and sandy residue of about 7·6 per cent.

The sands which cover the Bunda cliffs are more often consolidated, especially in the lower portions; and alternations of sand, sandrock, and travertine generally prevail in all the sections. Not unfrequently the loose sand beds are penetrated by stalactitic masses of consolidated sand, and have in them erect stole-like masses of the same material in various shapes and sizes, the latter ranging up to one foot in diameter and up to a height of two and a half feet. They must have originated from the precipitation of carbonate of lime around roots, branches, and stems of shrubs, whilst they possessed consistency; and the cavity which was formed by the subsequent decomposition of the vegetable matter was filled by the same process. Similar concretionary bodies have been described by Flinders, as entombed in the calciferous sands of Bald Head, King George's Sound; but he mistook them for corals, whilst the true explanation of their origin was left to Charles Darwin (vide Journal of Naturalist, 12 ed.. p. 450). And their

occurrence in the sand dunes at various points on t
coast line of this continent is now well known.
Though I cannot disabuse my mind of the belie
whole front of the Bunda cliffs was once faced wi
sands, in continuation of the now terminal portions, yet
reconcile it with the fact of the existence of deep water
the shore of a coast line without a beach, without adu
The necessity of some considerable elevation to form a
truncated littoral margin of the cliffs of consolidated
evidences loss by marine denudation, and extension seaw
The depression that is demanded by the present position of
recent marine deposits of Roe Plains, Yalata Swamp, &
militates against the opinion that the consolidated blown sand
and marine deposits are synchronous. In fact, the onl
explanation to meet the requirements of the case is that during
the formation of the consolidated sand the coast line was much
further seaward than now; since then a depression, perhaps
not exceeding twenty to thirty feet, below present sea level,
followed by an elevation which seems to be progressing at this
time.

The higher antiquity of the consolidated sands may be
indicated by the use of the term "Pleistocene," whilst the later
deposits may be spoken of as "Recent Marine" and "Sand
Dunes."

The oolitic limestones described by Eyre as covering much of
the surface of the country from Fowler's Bay to beyond the
Head of the Bight can only be the travertines and sand rocks
containing fragments of limestones, such as I have described at
Fowler's Point.

The fragments in these limestone breccias, or as enclosed in
concretionary travertine, are usually black, irregular in outline,
and their surfaces more often pitted or weathered; from which
appearance one might be well excused from committing the
error, on a cursory examination, of calling them scoriæ. One
source of the black discoloration of the usually light-colour
tertiary limestones is the carbonization of the fatty matte
animals which has penetrated into the stones, in the proc
cooking *à l'aborigine*; and is probably the true explar
the black nuclei to the concretionary travertines wh
unfrequently found on the cliff tops over the River
about the shores of St. Vincent's Gulf. But
Plateau, such stones are too widely spread, a
from the haunts of the aboriginals to have
such agency. My attention was arous
journeyings to make any very extended
much I noticed—that the samphire-c
post p. 120), where surrounded by o

strewn over with black angular stones; in some the discoloration had not penetrated far beyond the surface, and these stones could at once be identified, with either the crystalline limestone or the travertine crust. The colour which is discharged on submitting the stones to a red heat, is doubtlessly of a vegetable source; not due to the growth of algals, because too deep and lasting, but to the imbition of vegetable infusions, and their subsequent partial decomposition or carbonization.

The recent sand dunes on the Bight coast attain considerable elevations where they rest upon the Pleistocene sands or upon the older tertiary escarpment; the colour of the sand is usually dirty-white or grey, sometimes snow-white, but never of the reddish hue of the older series, though like them they contain a very high percentage of calcareous matter. The view presented by the Peelunibie sand dunes, at the Head of the Bight, as seen on a bright sunny day, is one not likely to be effaced from the memory. To all appearance we were looking towards a high mountain range whose base was encumbered with dark-coloured rocks, and whose crown was laden with snow. The illusion was strangely perfect, for the so-called snow and the rocks were as uniform and apparently consistent as though they were the genuine components of an Alpine landscape. As we approached, the wonderfully beautiful and refreshing spectacle gradually lost its grandeur, through diminution of its apparent height and massiveness; and finally the black coloured rocks were seen to be the dark green foliage of bushes, and the snow to be the domed tops of white sand dunes whose bases were clothed with shrubs. The whiteness of the sand is due to the fragments of bleached shells of *Donacilla elongata*, which constitute the whole or nearly the whole of the coarser part of the sand; whilst the finer part, which is less than a moiety, is comminuted shelly matter, though of not so white a colour. These sands have a maximum elevation of 180 feet, but this height is only attained where they have surmounted the escarpment of the older tertiaries.

The only permanent water in the country around the Bight is derived from the sand dunes and Pleistocene sands. Water is, however, not always procurable in the sand dunes, the supply being most abundant in those which are devoid of vegetation. At Fowler's Bay water is thrown to the surface by the pipe-clay of the Yalata swamp; but in most instances the fresh water is simply buoyed up by the sea water.

The Soil of the Bunda Plateau is a reddish coloured loam or loess, and near the coast has a thickness of as much as eight to ten feet; and in its upper two feet or so is crowded with the shells of *Helix* and *Bulimus*. Its thickness diminishes beyond the northern boundary of the oasis, and in the more interior

parts visited by me it is confined to slight depressions in the prevailing limestone surface. It is evidently the residue of the disintegration of the miocene limestone, an analysis of which shows it to contain about six per cent. of insoluble matter. Its limited extent in the interior tracts is doubtlessly due to a combination of circumstances reciprocal in their action. The absence of timber and almost of vegetation does not favour its formation nor its retention. The moistening vapour of the sea breezes does not reach the interior to clothe the parched and naked rock. What little is formed is for the most part removed by the action of the wind, and transported to those parts where conditions prevail favourable for its retention.

Meteorology.

Very little is known respecting it, and observations have only recently been commenced at Eucla and Fowler's Bay. The rainfall around the Head of the Bight is very small, and is mainly brought by the south-east winds. Heavy rains are unfrequent; and that the prevailing rains are of the nature of coast showers is evidenced by the diminution of rain in advancing in a north-west direction from Port Lincoln, as exhibited by the following records extracted from "Meteorological Observations," by C. Todd, C.M.G., &c.:—

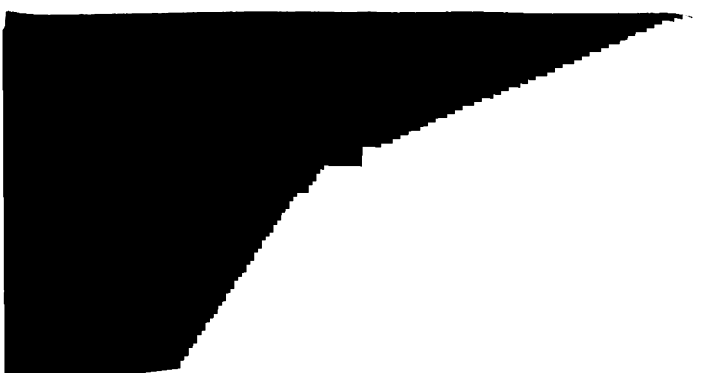
Year.	Port Lincoln.	Streaky Bay.	Fowler's Bay.	Eucla.
1876.	16·210 inches	...	...	11·330
1877.	22·440 "	...	...	13·775
1878.	17·290 "	16·135	10·314	5·892

The number of days on which rain fell during 1878 was at Port Lincoln, 115; at Streaky Bay, 77; at Fowler's Bay, 74; and at Eucla, 65.

Independent evidence of the above nature is furnished by the officers of the survey schooner, obtained during the autumn of 1879, between Fowler's Bay and the Head of the Bight:—"It is strange that very much more rain falls in the sea near the shore on this part of the coast than on the land, and on one occasion nearly two inches of steady rain fell in six hours. Within ten miles of Fowler's Bay and at the tidemaster's tent at Fowler's Bay there was none at all."—*S. A. Register*, May 27, 1879.

One proof of the scarcity of rain and the rarity of rain storms on the Bunda Plateau is the fact of the preservation to this day of the tracks of the horses forming Forrest's equipment which were made in July, 1870.

From the general character of the rainfall on the coast it may be inferred that the amount is less at the Head of the Bight than at Fowler's Bay or at Eucla, and that it decreases



as the distance from the coast increases. Indeed, the aspect of the vegetation demands that such is the case.

Thermometric readings taken exclusively on the Plateau, and embracing a period of twenty days in the month of February, give a mean temperature of 75 deg. at 9 a.m., and of 87 deg. at 3 p.m. The highest temperature recorded was 109 deg. on the 4th. The changes of temperature were pretty regular; at 9 a.m., 75 deg.; at 3 p.m., 87 deg.; at 6 p.m., about 75 deg.; cooling rapidly after sundown, and becoming bitterly cold between 4 and 5 a.m. Only on a few occasions did I note the temperature at these early hours. The following table exhibits the range of temperature observed on four days:—

Date.	Time.	Temp.	Diff.
Feb. 2	5·30 a.m.	58·5	36·5
	3 p.m.	94·	
" 3	5·15 a.m.	55·	54·
	3 p.m.	109·	
" 18	7 a.m.	54·	
" 22	6·23 a.m.	44·	38·
	3 p.m.	82·	

The unusually cold mornings betokened hot days, and the greatest difference of temperature of 59 deg. was recorded on the 28th of January, while at Coymbra. At 4.30 a.m. the temperature was 53 deg., at 9 a.m. 94 deg.; and the maximum was 112 deg.

In consequence of the calm and clear nights, and with a temperature frequently falling below dew point, dew should be copiously deposited; but it seems that the atmosphere over the dry surfaces of the interior part of the plateau had little or no moisture to give up during the time of my sojourn, as no dew was observed. But near the coast there was frequently a copious precipitation of dew, and it was a matter of observation that the quantity rapidly diminished inland, and beyond the limits of the timber trees appeared to be nil.

Botany.

The number of plants inhabiting the Plateau is very small, and is for most part made up of shrubs or shrubby perennial herbs. Some species appear to be confined to the rocky edges of the cliffs, such as *Correa speciosa*, var. *magnifica*, *Eremophila Browni*, *E. alternifolia*, *Goodenia varia*.

Whilst the under cliff of consolidated sand, which extends for about sixteen miles east from Wilson's Bluff, yields a number of species not met with on the Plateau, though familiar plants beyond it, conspicuous among which are *Lavatera plebeia*, *Scævola crassifolia*, *Nitraria Schoeberi*, *Templetonia retusa*, *Kochia oppositifolia*, *Enchylæna tomentosa*, *Oxalis corniculata*. These plants here find favourable conditions for growth

arising from the depth of drift material brought down from the edge of the Plateau, which retains much of the accumulated rainfall gathered in the gully-like channels which seam the face of the cliff slope. Here a luxuriance of grass prevails, not only in the watercourses, but along the cliff slopes below the level of the crystalline limestone. Their roots here find moisture, and protection is afforded them from the sun's rays by the rocky *debris* which encumbers that part of the cliff slope.

The Bunda Plateau on its western edge is bounded by a belt of mallee and tea tree, which continues along the edge of the escarpment to near Wilson's Bluff, whilst parallel to the coastline it is situated at about from two to three miles from the edge of the cliffs. At about 20 miles from the escarpment over Eucla the mallee, which appeared among the other trees at a few miles to the east, begins to predominate, and for fifteen miles forms a dense scrub. Tracing it around the coast it soon thins, and on the meridian of Mallabie is about one mile wide, open, and the trees of low stature. To the east of this the mallee disappears, and is not again seen till the margin of the Peelunibie sandhills is reached; thence it continues in a generally north-east direction, and occupies the surface of the sandy country southward to the coast. However, the extensive sandy region resting on the east side of Pidinga rock-basin is covered with a thick, not dense, scrub of mulga (*Acacia* sp.).

Lying inside the belt of mallee scrub is an extensive oasis occupying a breadth of from six to ten miles on either side of the telegraph line, which thus nearly traverses its longer diameter. Its dimensions are 110 miles long and its average width eighteen miles, or an area of about 2,000 square miles. Throughout this oasis mulga and sandalwood are the only trees. These occur thinly scattered where the soil is loamy, but are clustered on the travertine surfaces. This open country is well grassed, the grassed parts interspersed with blue bush (*Kochia sedifolia*), *Scævola spinescens*, *Fusanus acuminatus*, &c., sometimes the bushy plants dominating over wide areas. Intervening between the mallee scrub and the coast is a sterile belt, with occasional tussocks of harsh grasses, almost leafless *Scævola spinescens*, stunted *Choretrum glomeratum*, now and then with dwarfed *Nitraria Schoeberi*, and saltbush (*Atriplex* sp.), but for the most part carpeted with a prostrate *Melaleuca* and *Eucalyptus*, and *Eremophila densifolia*. The habit of the two myrtaceous plants is clearly due to the action of the wind, because as they retire from the coast they graduate into low bushes, and gradually acquire their usual stature. At eight to ten miles from the coast, particularly on the eastern side of the Plateau, the effect of the wind on the sandalwood

trees is strikingly apparent in their wand-like trunks and branches and leafy crowns, looking like mallee, bending to the north-west, in which direction they are forced by the strong winds from the south-east which prevail at their chief period of growth.

One characteristic feature of much of the vegetation of this western part of the coast tract is its heath-like habit, as seen in *Melaleuca*, *Eremophila densifolia*, F.M., *var.*, transporting one mentally to the Scotch moors or those of North England.

At about halfway between Eucla and the head of the Bight sand begins to appear, and with it a change in the vegetation, grass increases in quantity, the broom-like *Eremophila* appears, and most of the heathy plants become sparse or disappear. This change is very gradual, but becomes the greater as the extent covered by the sand drifts is widened.

To the north of the oasis there is a treeless region, called on the maps the Nullarbor Plain. It is, however, structurally a part of the Bunda Plateau, and there is no abrupt line of demarcation between it and the oasis. My notes having reference to the aspect of the vegetation on the N.W. journey from Mallabie are as follows:—

At 6 miles.—Grassy with few sandalwood trees and low bushes; signs of drought, as does a good deal of the country already passed over.

At 9 miles.—Much broom-like *Eremophila (E. scoparia)*, stunted fusanus *(F. acuminatus)*, *Choretrum glomeratum*, *Olearia conocephala* (bluebush), and a few sandalwood trees.

At 16 miles.—Treeless, much broom, little bluebush.

Beyond 21 miles.—Broom low and scanty; saltbush and prickly *Scævola* abundant but mostly dead, patches of shrubby samphire *(Salicornia arbuscula)* around bare subsaline surfaces of red loam in the slight depressions of the ground. Tufts of dead grass occasionally.

The contrast of colour presented by the vegetation on this arid interior is very striking, and is best exhibited in the N.E. part of it. On the slightly rising ground a blue tint prevails from the massing together of the blue bushes of two species, *Kochia sedifolia*, *Olearia conocephala*, and over the depressions of the surface the colour is dark from the black-green or almost black of the samphire, whilst intervening between the two colours is a gray belt produced by the salt bush (*Atriplex* sp.)

The interior has a few peculiar plants, but is characterised by paucity of species and their depauperised state. On the 22nd February, the total number of plants observed throughout the day's journey of 21 miles, was only fifteen, including bluebush, cotton bush, saltbush, samphire, *Salsola Kali*, *Zygophyllum* sp.,

Kerolæna diacantha, some withered composites, a grass, and her annuals. Around our camp on Feb. 8 a fewer number as seen.

The depauperization of species is not altogether attributable to the absence of soil, for long before the crystalline limestone forms the surface of the ground, reduction of size and disappearance of species is observable. The main cause must be hygrometric. Rain when it falls must rapidly pass away by absorption over much of the area, or by evaporation from the less pervious surfaces, which, judging from the extreme dryness of the air must be very active, but the rainfall is certainly very small, and precipitation of dew barely possible. That the vegetation has a struggle to maintain itself against such adverse conditions is evidenced by their stunted growth, absence of flowers or fruit, and generally by the blackened, and decayed or decaying appearance that it presents as a whole. Grass in most places was recognised by blackened spots on the surface, whilst the numerous dead or partially leafless shrubs attested to the long period which had elapsed since sufficient rain had fallen to produce growth, or flowers and fruits. Further, whilst all the plants of the desert tracts excepting *Eremophila scoparia* presented no traces of flowers or fruit; individuals of the same species were met with elsewhere in different stages of maturity, and the yellow straws among the blackened tufts of grass bespoke a recent growth. It is probable that after continued rain a vigorous growth of vegetation takes place, grass and other annuals appear, and for a few weeks all seems verdure, but is followed by prolonged droughts, during which the perennial plants only can continue to live.

The Bunda Plateau is perhaps the least Australian in its botanical features of any part of the continent. The absence or fewness of species of *Proteaceæ*, *Thymeleæ*, *Pittosporeæ*, *Leguminosæ*, and *Myrtaceæ* make this part of Australia quite an anomaly. One can hardly conceive of so vast a tract without gum-trees, casuarinas, grevilleas, hakeas, banksias, xanthorræas, pimeleas, xerotes, ferns, &c. The desert character of the flora is indicated by the numerical strength, either of individuals or species of *Chenopodiaceæ*, such as *Kochia*, *Rhagodia*, and *Atriplex*, *Compositæ*, *Eremophila*, &c., and by the absence or rarity of *Proteaceæ*, *Myrtaceæ*, *Epacrideæ*, &c.

List of Species of the Bunda Plateau.

Note.—The species marked by an asterisk have not yet been discovered beyond the limits of this region. Those marked thus †, are recorded for the first time as occurring within South Australia; or are not included in Schomburgk's Flora of the Province.

Order Cruciferæ.

* † Blennodia Richardsi, F. M. *(Richards.)*

† Capsella pilosula, F. M. *(Richards.)*
* † Capsella Drummondi, F. M. *(Richards.)*

ORDER MALVACEÆ.

Lavatera plebeia, Sims, of very slender habit and purple flowers. Bunda undercliff.
† Hibiscus Farragei. *(Richards.)*

ORDER ZYGOPHYLLEÆ.

Nitraria Schoberi, Lin., edge and slopes of Bunda cliffs towards the west.
Zygophyllum Billardieri, Dec. *(Richards.)*
† Zygophyllum glaucescens, F. M. *(Richards.)*

ORDER GERANIACEÆ.

Oxalis corniculata, Lin. Slopes of Bunda cliffs on the west.

ORDER RUTACEÆ.

Correa speciosa, Ait., var. magnifica. Rocky parts of Bunda cliffs.

ORDER LEGUMINOSÆ.

Templetonia retusa, R. Br. Sandy parts of Bunda undercliff.

ORDER MYRTACEÆ.

Eucalyptus, sp., and Melaleuca sp. See. p. 119.

ORDER LORANTHACEÆ.

Loranthus linophyllus, Fenzl. On *Acacia* sp., edge of desert tract.
Loranthus pendulus, Sieb., var. melaleucæ, Lehm., on *Fusanus*.
Loranthus Exocarpi, Behr., on Melaleuca.

ORDER COMPOSITÆ.

Minuria leptophylla, Dec. *(Richards.)*
Toxanthus Muelleri, Benth. *(Richards.)*
† Helipterum roseum. *(Richards.)*
* † Helipterum Haigii, F. M. *(Richards.)*
† Helipterum tenellum, F. M. Between Fowler's Bay and Eucla. *(Richards.)*
* Cephalipterum Drummondi, A. Gray. In the interior from the Head of the Great Bight. *(Delisser.)*
Ixiolæna tomentosa, Sond.
Olearia conocephala, F. M., (blue-bush). Widely diffused over the Plateau.
Brachycome graminea. Sandy soil, edge of Bunda cliffs.
* † Brachycome Tatei, F. M (MS.) Rocky edge of Bunda cliffs.
Senecio Cunninghami, De C. Sand patch near Wilson's Bluff.

Sonchus oleraceus, Linn. var. Sand dunes near Wilson's Bluff.

ORDER GOODENOVIEÆ.

Goodenia varia, R. Br. Rocky edge of Bunda cliffs.

Scævola crassifolia, Labill. Sandy undercliffs on western part of Bunda Plateau.

Scævola spinescens, R. Br. Widely diffused over the Plateau.

ORDER MYOPORINEÆ.

Eremophila Browni, F. M. Rocky edge of Bunda cliffs west.

Eremophila alternifolia, R. Br. With the last.

† Eremophila Weldi, F. M. Variety with roundish leaves. Bight Plateau.

* † Eremophila Delisseri F. M. (cotton bush). On the east side of the plateau, between head of Bight and Pidinga. The type specimens were obtained by Delisser, N.W. of the head of the Great Australian Bight, in Western Australia.

Eremophila scoparia, F. M. (broom). Over the desert tracts, very abundant.

† Eremophila densifolia, F. M., var. On the south-west and west margins of the Plateau.

ORDER CHENOPODIACEÆ.

Rhagodia spinescens, R. Br. Under shelter of trees, edge of desert.

Chenopodium nitrariacea, F. M. Sandy undercliff, Bunda Cliffs west.

Atriplex sp. (saltbush). Common over Nullarbor Plain.

† Atriplex phlebocarpum? ("large saltbush.") About Coompana, in the oasis.

Enchylæna tomentosa, R. Br. With *Chenopodium nitrariacea*.

Kochia oppositifolia, F. M. Slopes of Bunda Cliffs west, and by seashore.

Kochia sedifolia, F. M. (*blue-bush*). Widely diffused, but sparingly in arid parts.

Sclerolæna diacantha, F. M. On stony surfaces in arid parts.

Salicornia arbuscula, R. Br.. Widely diffused in desert tracts.

Salsola Kali, Lin. Occasionally in arid parts.

ORDER LAURINEÆ.

Cassytha sp. Rocky slopes of Wilson's Bluff.

ORDER SANTALACEÆ.

Fusanus acuminatus, R. Br. Widely diffused.

Choretrum glomeratum, R. Br. (*mamla*). Widely diffused.

The species collected by Corporal and Mrs. Richards, of Fowler's Bay, are inserted on the authority of Baron von Mueller *(Fragmenta Phytographiæ Australiæ.)* The specimens of the Richards-collection were gathered on the Bunda Plateau, though "*prope* Eucla."

In the determinations of the species collected by myself I have been assisted by Dr. Schomburgk; but some critical species have been named by Baron F. von Mueller.

Zoology.

From the botanical features of the Bunda Plateau much might be anticipated regarding the distribution and character of the constituents of its fauna; where the richer flora prevails there live the greater number of species and individuals. The numerous deserted burrows of animals which were observed in the desert tracts seem to point in the same direction as that indicated by the plants; that is, to continued droughts.

Class Mammalia.—Canis dingo is widely spread, and was seen farther inland than any other mammal. Though reddish-yellow is the common colour of its fur, yet black is not rare, and white has been observed. The crevices of the Bunda cliffs are its favourite resorts, and a well-beaten track extends along the edge of the cliff from end to end.

Macropus fuliginosus is the only kangaroo; it was not abundant, and was seen only in the lightly-timbered parts.

Bettongia campestris, or weelba, is the commonest mammal in the oasis; and though exceedingly timid in the day time, exhibits little fear of man at night, and is a daring thief. The flesh much resembles rabbit.

Phascolomys, sp., occupies the eastern half of the Bunda oasis, and extends far inland. It would appear to have here reached its western limit. This wombat is very distinct from the species near Adelaide, and is identical with that named *P. niger* in the Institute Museum. I have not, however, adopted that name, as I am not aware that it has been published, and because it is rather inappropriate. The fur or *soft hair* is a mixture of black and grey on the back, light coloured below. The animal lives in deep burrows, chiefly excavated in the loamy soil to depths of seven or eight feet, or under the travertine cover; it is the chief animal food of the wild aboriginal.

Perameles was not seen alive, but its remains were found in the caverns frequented by owls.

Hapalotis conditor, or walkla. This small rodent, conspicuous by its large ears, is known as the building hapalotis, from the circumstance that colonies of them erect over their burrows massive structures of interlacing small branches. It is the chief food of Strix N.-Hollandiæ which inhabits this country.

A small mouse-like animal—whether a rodent or a marsupial I cannot say, not having seen it—would seem to have been very plentiful at one time in the arid tracts, as its long shallow burrows—which it is said to close with small stones—were conspicuous objects all over the treeless country, wherever there was a sufficient depth of soil.

Class Aves.—A moderately great variety of birds was observed in the oasis. *Strix Novæ-Hollandiæ* finds a suitable retreat in the caverns; whilst *Aquila audax* was not unfrequently seen, and hunting in pairs. *Corvus australis* clings to the neighbourhood of the water-holes. *Cacatua Leadbeateri* would seem to be almost a straggler in this region, as only one flock was seen; and singularly at about the same place that Eyre met with the bird. In the oasis, particularly in its western parts, several species of parakeets were observed, though not identified. A lark inhabits the coast tract, whilst small finches, flycatchers, honeysuckers, emu wrens, *Geobasilus regulus*, and *Lichmera Australasiana*, are common in the timbered region. The ubiquitous bustard, *Choriotis australis*, is widely spread.

Class Reptilia.—Of Ophidians I saw but few individuals of not more than four species, and all within the oasis. *Pseudechis porphyriacus* (Shaw), black snake; *Hoplocephalus minor* (Gunther), desert snake; *Acanthophis antarctica* (Wagler), death adder.

Lizards were met with over a much wider area; indeed, they occur where no other conspicuous form of animal life were to be seen, though in the latter case the species were a small *Mocoa* and a small *Grammatophora*. The species observed were: *Monitor Gouldi* (Gray), iguana, in the oasis; *Trachydosaurus rugosus*, sleeping lizard, widely spread; *Egernia Cunninghami*, near the coast; *Diplodactylus marmoratus*, under stones along the cliff edge. *Grammatophora*, n. sp.? seven inches in length, colour of back, yellowish-brown banded with white; *Grammatophora*, n. sp.? similar in size and coloration to *G. Adelaidensis*, but differing particularly in the depressed head; *Grammatophora*, sp.; *Hinulia*, two sp.; *Mocoa*, two sp.

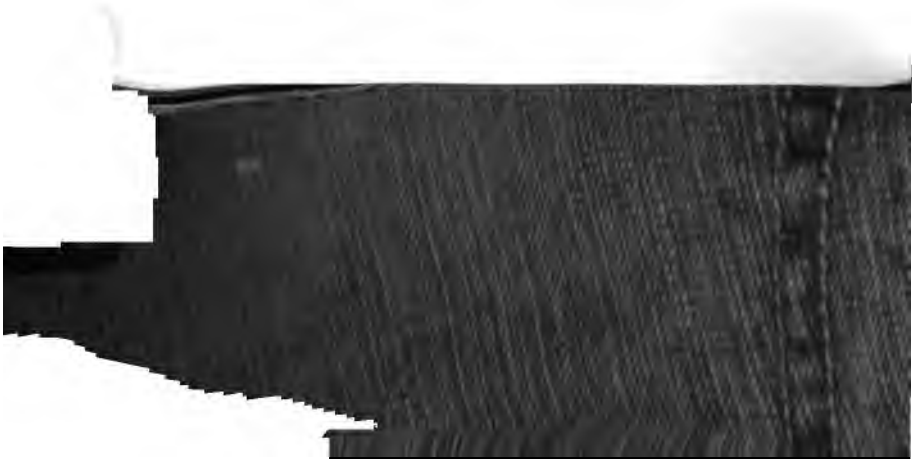
The class Insecta is represented by several brilliant and one very large yellowish-brown species of *Stignoderma*; a very large chesnut brown diurnal longicorn; many vespidæ, singularly shaped ichneumons, large dipters, all of which are attracted by the fresh blossoms of mallee and teatree. Clicks, weevils, and ground beetles of the family *Brochidæ*, the latter characterised by nodosities on the elytra. One of the largest Brochidæ emits when handled a brown fluid from its mouth, and produces a noise audible at the distance of several yards by rubbing the depressed sides of the abdomen against the

thickened and incurved edges of the elytra; another, but smaller, species is widely spread, and is the chief food of the *Grammatophoræ*. An interesting form of Elaterinæ was captured, one inch long, and of a brown colour marbled with white. Two small species of butterflies, an *Ogyris* and another, were seen in the oasis. A few species of *Blattidæ* are active during the daylight, but I never saw a single winged form. One small species which is common has the upper surface studded with small tubercles and longitudinal ridges. A species of *Polyzosteria* as beautiful as *P. Mitchelli*, Angas (*Blatta*), was also taken; it differs from it a little in shape, but chiefly in the coloration.

Spiders are chiefly represented by large *Lycosæ*, whose open vertical burrows, lined with web, are to be found wherever the soil is suitable. One species was noted to have the cephalothorax brown with black rays, thighs black, rest of legs grey, abdomen with bands of black and grey. Some nondescripts were collected; but, like all the soft-bodied animals when placed in the spirit-bottles, they did not withstand the disintegrating effect of camel transport. A singular form was captured on the grey surface of a stone near Wilson's Bluff, which was of a dirty colour, and had a prehensile abdomen—that is to say, that part of its body was much depressed and somewhat narrowed posteriorly, which, when the animal was touched, was firmly applied to the angular edge of the stone on which it rested. In this squat attitude it looked like a small lump of dirt, and, confident in its powers of mimetism, it refused to be roused into activity. Several times did I change its position, but in every instance did it bring the clasping power of its abdomen into requisition. Another species was of a triangular shape, and of the colour of dead sandalwood, stripped of its bark, on which it was caught.

A slender and pale yellow-coloured scorpion lives under stones along the cliff top, and among dead timber in other parts of the Plateau. A large centipede was taken from the stomach of a *Grammatophora*, the only example observed.

Land Mollusca.—In such districts as I have described the presence of land snails is paradoxical; yet, nevertheless their prodigious abundance, even on the sterile portions of the Bunda Plateau, is one of those features which has not escaped the observation of some of my predecessors. Eyre noted the profusion of snail shells along the line of his march, but incorrectly referred them to fresh water forms. (See ante p. 101). The species most conspicuous for their abundance are *Helix nullaborica*, n. sp., and *Bulimus indutus*, Menke, *var. nov.*; they may be gathered by the barrow-loads under the larger bushes, and are thickly strewn over the open country; indeed, it is no exaggeration to state that every other step that is taken in



walking will crush down a snail shell. But living examples are rare except in very favourable situations; they are to be obtained by pulling up the bushes by the roots, alongside of which they bury themselves to the depth of an inch or two. Here they may be said to dwell in a moist atmosphere during æstivation, as the dew collected on the twigs, when in sufficient quantity gathers together and trickles down the stem, and thus renders humid the soil immediately about the base of the bush. *Bulimus indutus* possesses an advantage over its congeners in closing the aperture of its shell by a testaceous epiphragm, which must more securely prevent dessication of the animal than if the aperture were closed by the filmy structure which is formed by the other species. Another South Australian Bulimus, *B. Mastersi*, which extends westward as far as the sandhills at the head of the Bight, constructs a similar defensive armature. The rarity of living examples of these snails forces one to the inevitable conclusion that the immense numbers of their dead shells, both on and beneath the surface of the soil, represent the accumulation of centuries of generations. The snails seem to have no enemy; and in a country where the forces of nature appear to be so equable, the preservation of their shells for long periods of time is not a matter for wonder.

Helix Nullarborica, *Bulimus indutus*, and *B. Adelaidæ* occur over the whole of the Plateau traversed by me. *Helix cyrtopleura* is also abundant, but more estricted, and, unlike the other species, is confined to the Plateau, where it chiefly affects the rock surface and debris of the western part of the Bunda cliffs, and about the caverns and stony ground inland. *Pupa australis* occurs over much of the better lands. All the above, excepting *Helix cyrtopleura* live in the sandhills at the head of the Bight, at Mundyarra, near Wilson's Bluff, and at Eucla, where they are accompanied by *Helix arenicola*, Tate, and *Pupa Maryarettæ*, species not seen on the Plateau. Of the above species *Bulimus indutus* is an addition to the South Australian fauna, and *Helix Nullarborica* is new to science. *Bulimus Adelaidæ*, *Pupa australis*, and *Helix arenicola* are the most widely diffused of our land snails.

MARINE CONCHOLOGY AROUND THE HEAD OF THE GREAT BIGHT.

The littoral life in these waters is that which prevails on the rough water shore throughout the southern coast of the continent. The species are few in number, though individuals abound. The majority of them are characterised by thick tests. Judging from the shells cast up upon the limited beach-line facing the ocean, the laminarian and deeper water forms are not so numerously represented as in the quiet waters of Fowler's, Streaky, and other bays.

The rocks uncovered at low tides are inhabited in the upper region by *Littorina caerulescens*, *Siphonaria Diemenensis*, *Acmæa alticostata*, *Patella tramoserica*, *P. Gealei*, **Trochocochlea chloropoda* (Tate), *T. constricta*, *T. striolata*, *Chiton petholatus*, *Mytilus Menkeanus*, and *M. hirsutus*, amongst which nestles **Lasea rubra* (Mont.) In the lower region live *Nerita atrata*, *Turbo undulatus*, *Diloma odontis*, *Acmæa septiformis*, *Purpura textiliosa*, *Cominella alveolata*. The sandy shore is the habitat of *Natica Baconi*, **Donax* (cf.) *epidermia* (small, with denticulated margins), *Donacilla præcisa*, *D. elongata*.

The commoner and the conspicuously-large shells which are cast up on the sandy beaches at the Head of the Bight, near Wilson's Bluff, and at Eucla are:—*Triton Waterhousei*, **Melo Miltonis* (Gray), *Cassis fimbriatus*, *Conus Anemone*, *Turritella clathrata*, *Amalthea conica*, *Phasianella bulimoides*, *P. ventricosa*, *Clanculus gibbosus*, *Thalotia picta*, *Gibbula Preissiana*, *Turbo lamellosus*, *Haliotis glabra*, *Bulla oblonga*, *Mactra rufescens*, *M. pura*, *Arcopagia decussata*, *Chione strigosa*, **C. Victoriæ* (T. Woods), *Marcia faba*, *Soletellina epidermia*, *Cardium cygnorum*, *Modiola australis*, *Arca lima*, **A. trapezia* (Lamk.), *Pecten asperrimus*, *Spondylus tenellus*, and *Cuneus galactites*. *Retepora phœnica*.

Those marked with an asterisk in the above lists have not previously been recorded for South Australia, though known to me as occurring elsewhere in our waters. One species only I consider to be new to science, I have named it *Trochocochlea chloropoda*.

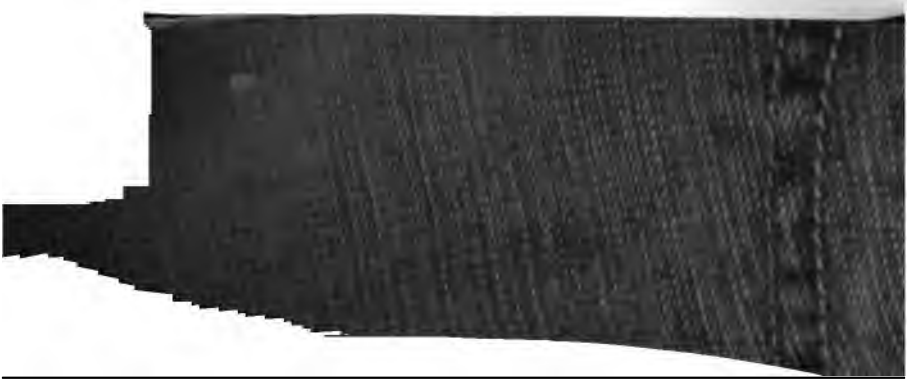
Beyond the limits of the coast-line of Bunda Cliffs, especially in the sheltered bays to the east, the molluscan life is very rich, and the collections obtained at Fowler's and Streaky Bays contain several novelties and many forms hitherto thought to be confined to the eastern shores of the continent. The consideration of these will be reserved for a separate paper.

Explanation of Plate IV.

Fig. 1. Section from the Pidinga rock basin, bearing S.W., distance seven miles. Vertical scale one-fourth inch to 100 feet. Strike of metamorphic rocks N.N.E.

Fig. 2. Diagramatic section near the Head of the Bight, view facing S.W. Vertical scale, 80 feet to one inch (see page 114).

Fig. 3. Profile of Wilson's Bluff, Bunda Cliffs (see page 105) Vertical scale, 100 feet to one inch.



ZOOLOGICA ET PALÆONTOLOGICA MISCELLANEA,

CHIEFLY RELATING TO SOUTH AUSTRALIA.

By Professor RALPH TATE, Assoc. Lin. Soc., F.G.S., Corr. Memb. Acad. Sc., Philadelphia, Roy. Soc. Tasmania, &c.

ON A NEW GENUS OF FOSSIL LAMELLIBRANCHIATA.

FAMILY MACTRIDÆ.

GENUS ZENATIOPSIS, *nov.*

Etymology.—*Zenatia*, a genus of Mactridæ; and *opsis*, like.

Type.—*Zenatiopsis angustata*, nov. spec. Miocene. Australia.

Shell equivalve, inæquilateral, oblong; umbo anterior, *supported internally by a thick rib*, extending, with a slightly backward inclination, half way across the valve; narrowly gaping at both ends; cartilage plate prominent; cardinal teeth distinct, no lateral teeth; pallial sinus deep, horizontal.

Zenatiopsis combines the form and internal appearance of *Machæra* with the hinge characters of *Zenatia*; the resemblance of the only known species to *Zenatia acinaces* is very great, but the presence of an umbonal rib, like that in *Machæra*, is a valid reason for not regarding it as congeneric therewith. It is distinguished from *Vanganella*, as *Zenatia* is, by the dentition; whilst the anterior divergent rib of *Vanganella* supports the cartilage plate with which it is confluent; the internal rib of *Zenatiopsis* is an umbonal support, and arises from beneath the cardinal teeth.

The anterior adductor scar is close up under the hinge line as in *Zenatia*, and is bounded on the posterior side by the umbonal rib.

ZENATIOPSIS ANGUSTATA, *nov. spec.* Pl. v., figs. 6a, 6b.—Shell thin, compressed, narrowly oblong, back slightly convex; anterior end very short and rounded, posterior long rounded. Umbo small, apiculate. Dorsal and ventral margins near parallel. Surface shining, marked by a few slender plicæ of growth, and numerous fine coincident striations.

Dimensions of a large example from the "Upper vian":—

Total length	1·8
Length of anterior side ...	"
Height	

J

LOCALITY AND HORIZON.—The older tertiary of Muddy Creek, Hamilton, Victoria, and the contemporaneous "Upper Murravian," near Morgan (North-West Bend), on the River Murray. *(Tate.)*

Z. angustata is very much of the shape of *Zenatia acinaces*, Quoy, recent New Zealand and New South Wales, but it is much narrower, more attenuated posteriorly, and the anterior side is rather longer and not so abruptly arched. Specimens from the River Murray cliffs have thin, fragile, semi-pellucid tests; whilst those from Muddy Creek are thickish and opaque, and of larger dimensions. Similar differences are found among living species inhabiting the laminarian zone of the comparatively still waters of land-locked bays, and of the rough waters of the open coast line.

ON SOME RECENT AND FOSSIL KELLIADÆ FROM SOUTH AUSTRALIA.

LEPTON CRASSUM, *nov. spec.* Pl. v., fig. 9.

Shell thick, transversely oval, moderately convex; umbo post-median moderately inflated. Surface smooth, but, viewed under the lens, with narrow equidistant sulci and flat plications, punctatedly impressed in the grooves, particularly on the posterior and anterior sides. Anterior and posterior margins rounded, ventral margin nearly straight, dorsal slightly arched. Length ·25, breadth ·18 inch.

In the only valve, a left one, found of this species, there is a small cardinal tooth in front of the small cartilage pit, and the two laterals are elongated and erect.

Locality and Horizon.—River Murray Cliffs near Morgan (North-West Bend), Upper Murravian series.

LEPTON PLANIUSCULUM, *nov. spec.* Pl. v., fig. 12.

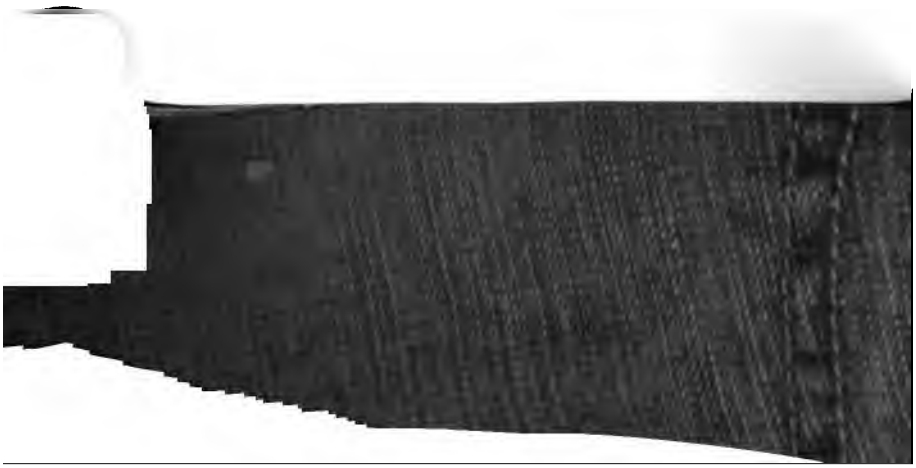
Shell minute, quadrately ovate, compressed, nearly equilateral, posterior side a little the longer; umbo prominent, acute; surface marked with strong folds of growth, which are broader and more elevated in the umbonal region, and very finely concentrically striated.

Right valve with divergent lateral teeth of equal and moderate size, between which is the broadly triangular cartilage pit.

Dimensions.—Length, ·175; breadth, ·15 inch.

Locality and Horizon.—In a sandy layer in the limestones of the Upper Aldinga series (Miocene), on the south side of Port Willunga Jetty.

This species comes near to *L. australe*, Angas (see p. 13), from which it differs in shape, in being more equilateral, and



in its strong folds of growth, and by its more produced umbo and umbonal ridge.

LEPTON TRIGONALE, *nov. spec.* Pl. v., fig. 5.

Shell triangularly ovate, pellucid, shining, yellowish-brown with contained animal. *Sculpture*, finely shagreened on the anterior and posterior sides, smooth in the middle, concentric undulations slender and rather distant. Umbones produced, small and acute; a little posterior. Ventral margin straight, or very slightly incurved, a little compressed medially. Hinge small; right valve with a large ligamental pit and two stout diverging laterals, no cardinal tooth; left valve with a minute ligamental pit, a small cardinal tooth adjacent, in front of which is a tuberculated lateral tooth, the posterior lateral is elongated, but not prominent. Dimensions of a very large specimen —Length, ·15; breadth, ·14 in.

Its triangular shape removes it from *L. translucidum* (Sow.) of New Caledonia, but allies it with *L. Adamsi* (Angas) and *L. concentricum* (Gould) of New South Wales. From the first it differs by the absence of the wide posterior plications, and its smaller size; from the second by its more symmetrical shape, absence of epidermis, less marked concentric sculpture, and in its dental characters. *L. australe*, Angas, is of a different type.

HABITAT.—Shell sand. Holdfast Bay, St. Vincent's Gulf (very common); Port Lincoln, and Streaky and Fowler's Bay on the west coast (Tate).

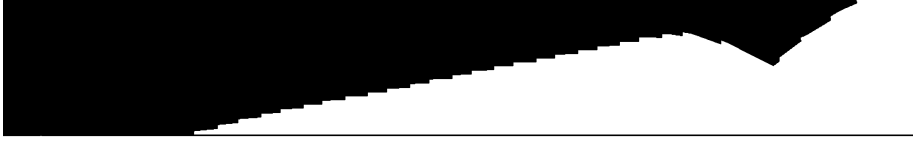
LEPTON AUSTRALE (Angas).

Ref. L. australis, Proc. Zool. Soc., tab. liv., fig. 14, p. 863, 1878.

To the original diagnosis I would add a few characters, chiefly supplied by larger examples than the types. The texture of the shell is transparent, and the sculpture consists of delicate microscopic striæ coincident with the undulations of growth, and radiating from the umbo, which is decidedly anterior. Antero-dorsal margin more oblique than as in fig. Left valve with diverging lateral teeth, the posterior one large and erect, the other inconspicuous; no cardinal tooth. Ligamental pit deep in both valves, the right with divergent lateral teeth of equal and moderate size.

Dimensions—Length, ·375 in.; breadth, ·310 in.

Habitat.—Dead shells on beach, and from six fathoms water, Holdfast Bay; among shell sand, Salt Creek, St. Vincent's Gulf; and among shell sand, Streaky Bay (Tate). Only a few specimens. Fossil in the Pleistocene shell limestones of the Port Adelaide Creek, not uncommon (Tate).



LASÆA RUBRA, (Montague).

Whether the little shell called *Poronia australis* by Sowerby is distinct from the typical European species above named must be left for more critical comparisons than I have been able to make. But now that the distribution of *L. rubra* has been better ascertained, and its existence in the Southern Hemisphere thoroughly authenticated, there seems very great reason to believe that several species have been founded on examples from our Australasian waters of this ubiquitous species. Forbes, P. Carpenter, and other distinguished conchologists were agreed as to its occurrence on either side of the N. Atlantic, in the Mediterranean, and in the Indo-Pacific region. Jeffreys has just announced its presence in Korea Strait, along with some other species common to the N. Atlantic and N. Pacific Oceans; and has ventured to express the opinion that these forms have originated in high northern latitudes, and have found their way to Japan on the one side and Europe on the other by means of a bifurcation of the great Arctic current. Jeffreys, moreover, extends its range to the Straits of Magellan and to the Islands of St. Paul and Amsterdam.

According to Gray, *Cyclas australis*, Lamk., from the Isle of Timor, with a variety from King George's Sound (Peron), is identical with the *Cardium rubrum* of the earlier English author; but so far as one can gather from Lamarck's diagnosis it is not certain that it is so, as Lamarck has not mentioned the station of his species. Deshayes considers the shell to be a *Pisidium*.

The *Lasæa australis* (Sowerby) inhabits New Caledonia (Sowerby), New South Wales (Angas), Tasmania (Woods); and I have collected it from Cape Northumberland to Eucla, nestling among mussels or under loose stones, and in the crevices of rocks above high-water mark; and have received specimens from King George's Sound.

The South Australian and King George's Sound examples are smaller than those from Tasmania, but exhibit considerable variation in sculpture; in some it is reduced to microscopic concentric striæ, and in others it is in the form of thick ribs. The colour is sometimes white, though the red stain along the hinge line remains. For these reasons, I cannot select any valid character by which to separate *L. australis* and *L. scalaris* (Phil.) from one another, and these names must go to swell the long list of synonyms of *L. rubra*.

PYTHINA GEMMATA, *nov. spec.* Pl. v., fig. 8.

Shell minute, oblong, inequilateral, thick, pellucid. Posterior side the shorter, roundedly truncated; anterior side produced, rounded. Umbo subinflated. Ventral margin nearly straight. *Sculpture*, as viewed under an inch objective; anterior and

posterior sides with divaricating granulose plicæ united in the median region by transverse rows of granules; the whole surface with regular incised lines coincident with the edge of the shell.

Interior of right valve with a bifid cardinal tooth in front of a ligamental pit, laterals one on each side stout and elongated.

Length, ·09; breadth, ·06 inch.

Habitat.—Shell sand Fowler's Bay, two right valves (*Tate*).

The shape and sculpturing recalls some *Goniomyæ*, in the latter character particularly of *G. heteropleura*, Ag., with this difference that the *en chevron* plicæ are inverted.

DESCRIPTIONS OF NEW SPECIES OF SOUTH AUSTRALIAN PULMONIFEROUS SNAILS.

HELIX SUBSECTA, *nov. spec.* Pl. v., figs. 2a, 2b.

Shell umbilicated, depressly orbicular, nearly discoid, solid, somewhat rugosely plicated, and obscurely but densely longitudinally striated, more conspicuously so on the anterior half of the body whorl. Colour greyish-white, somewhat porcellanous; epidermis? Spire slightly convex, whorls five; last whorl rounded at the periphery, anteriorly much depressed. Peristone thin, reflected, with an acute edge, but not thickened, nearly entire; aperture longitudinally ovate. Umbilicus large; its breadth being about one-fifth the major diameter of the base of the shell.

Dimensions.—Major diameter, ·625; minor diam., ·5; height, ·25 of an inch.

Locality.—Collected by Mrs. Kreusler, an indefatigable entomologist, in the Port Wakefield Scrub.

This species stands alone among the Australian Helices in its deflected aperture and almost entire peristome, associated with a depressed spire and open umbilicus.

HELIX NULLARBORICA, *nov. spec.* Pl. v., figs. 1a, 1b.

Shell narrowly umbilicated, globosely conic, very thick, surface of a dirty white colour, coarsely and closely wrinkled transversely, interrupted by equidistant incised lines, whorls 4½, rotund, and just perceptibly flattened at the suture, which is impressed. Last whorl somewhat inflated, descending but little in front, base convex. Aperture oblique, sub-circular, peristome sub-acute, slightly reflected, margins joined by a callus; columella margin thickly dilated above, and nearly covering the umbilicus.

Major diameter, ¼ inch; minor diam., $\frac{13}{20}$ths of an inch; height, ¾ of an inch.

Animal.—Foot brownish-grey, muzzle black with white spots, tentacles black, collar grey and creamy white.

Habitat.—In great profusion over the Bunda Plateau, and extending to the scrubby sandhills on its east, and to the Roe Plains, at the foot of the Hampton Range, in Western Australia.

Affinities and Differences.—*H. Nullarborica* has considerable resemblance to *H. Angasiana*, differing from it, irrespective of coloration, in its more globose form, minute umbilicus, in its wrinkled surface, and longitudinally impressed lines, and in the callous covering on the pillar.

The ridges of growth of the shell of *H. Angasiana* are regularly curved, and are interrupted by close set striæ, giving rise to a granulated appearance under the lens; but in *H. Nullarborica* they are wavy and varied in the degree of coarseness, whilst the incised longitudinal lines are distant from 20 to 25 on the body whorl, and help to give that pitted appearance to the shell which is observable by the unaided eye. The shell is moreover remarkable for its excessively thick test, for its semi-fossilized aspect, and is devoid of an epidermis. It is very constant in form and colour, though in size it presents great differences; the dimensions given are those belonging to a specimen of the common size. I may add, to avoid misapprehension on the subject, that I gathered many living examples.

The specific name is adopted from that of the treeless portion of the Bunda Plateau known as the Nullarbor Plain.

Bulimus sinistrorsus, *nov. spec.* Pl. v. fig. 4.

Shell sinistral umbilicated, oblong turretted, very thin, translucent, yellowish-horn coloured, showing under the lens regular fine transverse striæ. Spire elongated, gradually tapering, rather acute, whorls five, moderately convex, last whorl equalling one-third the total length of the shell. Aperture somewhat ovate; peristome white expanded, especially the columella margin; left margin with a white tooth-like callosity in the angle.

Length, ·18; breadth, ·06 inch.

Animal unknown.

Habitat.—Under small bushes on the sandy margin of the salt swamp at Peelunibie, Head of the Great Australian Bight, 50 examples observed.

This shell, though it resembles *B. Adelaidæ* in a few particulars, yet it cannot be regarded as a reversed form of it, as its regularly increasing whorls alone prove its distinctness. It may be questioned—Would it not be better to refer it to *Balea?* But its close affinity to *Bulimus Adelaidæ* induces me

to place it near that species. *B. sinistrosus* is a very different type of shell to *Balea australis*, Forbes, which is a decided connecting link with *Clausilia*, whilst the present species is a divergence from the typical Bulimi towards *Balea*.

BULIMUS INDUTUS, *Menke*, var. PALLIDUS, *nov.*

The large Bulimus so profusely abundant over the Bunda Plateau agrees so accurately in its dimensions with *B. indutus* of Western Australia that, despite the differences of coloration, I am constrained to regard them as of one species. Our shell has a white semi-fossilized appearance, and its columella is grayish-white, and the aperture is dull-white within. Menke describes the type as *fulva albida*, and the aperture as white within. Cox gives it a yellow epidermis, and the columella flesh-coloured.

The classification of the Australian Bulimi adopted by Dr. Cox places *B. dux* and *B. indutus* in different sections, an arrangement with which I cannot agree, as I believe that the two species are not more distantly related than *B. indutus* is to the variety above described. *B. Mastersi* belongs to the same natural group.

B. indutus var. *pallidus* is widely diffused over the Bunda Plateau, and the dead shells are to be met with in such prodigious numbers in many places that a barrow-load could be gathered within an hour, and over the less sterile portions a foot can hardly be set down without crushing one. Westward it extends to the Roe Plains, and eastward to Coymbra, and inland from thence for a few miles. It does not inhabit the country east from Fowler's Bay.

PLECOTREMA CILIATA, *nov. spec.* Pl. v., figs. 7a 7b.

Shell imperforate, fusiformly ovate, solid; shining brown-black, with a narrow light-coloured band near the suture, and between which is a reddish-coloured one. Surface ornamented with incised longitudinal lines and regularly wrinkled transversely; at the intersections of the lines, punctatedly impressed and ciliated; the cilia, yellowish-brown, filiform. Spire conoidal, rather pointed. Whorls seven, scarcely convex, with one shallow groove near the suture, the last forming three-fourths of the total length. Pillar with a posterior white tubercular tooth, and an anterior compressed spiral plait; columella with a similar plait, but smaller; outer lip with two tubercular teeth. Columella expanded and reflected at the lower angle to form a false umbilicus. Length, ·3; breadth, ·16.

Animal with the foot and neck bluish-grey; muzzle with dark annular streaks, short, broad, and flattened, slightly sinuated in front; tentacles with dark annular coloration, short, not extending to front of muzzle, pointed, dilated at the

bases. Eyes at the bases of the tentacles on the upper side, but slightly on the inner side of the axis of the tentacle, they are surrounded by a circular colourless space; foot short and pointed posteriorly.

Habitat.—Mangrove swamps about Port Adelaide; sheltering under shrubby-samphire, just above high-water mark, in company with *Alexia meridionalis*, Brazier, but not so abundant as that species (*Tate*). Among shell-sand, north side of Streaky Bay, probably inhabiting the extensive samphire flat about Acraman Creek, Streaky Bay (*Tate*).

DESCRIPTION OF A NEW SPECIES OF PHYLLOPODOUS CRUSTACEAN.

LEPIDURUS VIRIDULUS, *nov: spec.*

Animal, including flap of tail-segment, about an inch long, carapace rounded, elongate oval, of a brownish-green colour, covering the whole abdomen, excepting flap of tail-segment; keeled towards the extremity, ending in an acute point, lunately notched posteriorly, and sharply and conspicuously hooked on its margin. Front and lateral margins of the carapace smooth and thickened. The rings of the abdominal segments, dark-brown, are beset with stout spines, equi-distantly placed all round, and directed backwards. The flap of the tail-segment has a blunt keel along its whole length, with blunt prominences, and its edges are ciliately serrated. The filaments of the tail are about half the length of the body, and are clothed with fine cilia.

Habitat.—Collected by Thomas Tate, October 1878, in the flood waters of the "Reedbeds," near Adelaide.

Two Australian species of the genus have been described, *L. viridis*, so-called from its colour, inhabits Tasmania, and was diagnosed by Dr. Baird, Proc. Zool. Soc., 1850; and *L. Angasi*, of the same author, 1866, which is of a pale horny colour, and is common in the rain pools about Adelaide. *L. viridis* is characterised by its fine green colour, by its oval carapace covering less of the body than in *L. Angasi*, and the edges of the lower half of its length being serrated. *L. Angasi* is distinguished by its horny colour, its rounded carapace covering nearly two-thirds of the body, and by the smooth edges of the sides of the carapace.

L. viridulus differs from *L. Angasi* in colour, in the carapace covering more of the abdomen, its keel limited to the hinder part, and in the narrower and more spathulate tail flap.

NOTES ON THE CONCHOLOGY OF KING GEORGE'S SOUND.

During a recent visit to King George's Sound, Western Australia, my friend and colleague, Professor John Davidson, was kind enough to gather for me about a gallon of very coarse shell sand. The gathering has yielded thirty-eight species of mollusca, and as some of them are new and others not known to occur so far to the west, I have thought it worth while to place on record the following observations:—

King George's Sound is classic ground to the conchologist, as many of the earlier known Australian shells were obtained at this place. It was visited by the French surveying ship, commanded by Peron, and twenty-eight of the species then collected were described by Lamarck in his "Animaux sans Vertebres," 1818-1822. Its waters were again explored by a French surveying ship, the Astrolabe, and thirty-seven species then obtained were described by Quoy and Gaimard in the Zoological account of the voyage (1830-1833). Menke, in his "Molluscorum Novæ Hollandiæ," 1843, describes and refers to 185 species as belonging to Western Australia, some of which are recorded as inhabiting King George's Sound. These are the chief sources of information having reference to the marine shells of the west and south-western shores of this continent, and I am not aware of any attempt made to furnish a complete list of the shells of Western Australia. Of the shells not previously known to occur I record the following:—

TROPHON PAIVÆ, *Crosse*. Inhabits St. Vincent's and Spencer's Gulf, and has been collected at Port Elliot. Occurs in New South Wales.

TROPHON, *species undescribed*. Lives in the mangrove-swamp about Port Adelaide Creek.

DRILLIA HARPULARIA, *Desmoulins*. St. Vincent's Gulf, Lacepede Bay.

BITTIUM LAWLEYANUM, Crosse. Occurs in New South Wales, Victoria, Tasmania, and South Australia.

TURBONILLA ERUBESCENS, *n. sp.*

ALABA PAGODULA, Adams. Till now peculiar to St. Vincent's Gulf.

DIALA LAUTA, Adams. Very common in St. Vincent's and Spencer's Gulfs.

DIALA IMBRICATA, Adams. Specimens obtained by me from St. Vincent's Gulf have been so named by Mr. G. F. Angas.

CAPULUS SUBFUSCUS, Gray. St. Vincent's Gulf.

CLANCULUS RUBENS, Adams. South Australia and Tasmania.

THALOTIA CONICA, Gray. Tasmania, Victoria, and South Australia. Common at Fowler's Bay.

Utriculus apiculatus, *new species*.
Cylichna pygmæa, Adams. St. Vincent's Gulf.
Donacilla præcisa, *Deshayes*. South Australia and Tasmania.
Lasæa rubra, Montague. (See p. 182.)
Mytilus Menkeanus, Phil. Common in South Australian waters.
Modiola flavida, Reeve. St. Vincent's Gulf.
Mysella donaciformis, Angas. This New South Wales species I have collected abundantly at places in St. Vincent's Gulf. It has been identified by the original describer.

Descriptions of New Species.

Turbonilla erubescens, *nov. spec.* Pl. v. fig. 10.

Shell of the same dimensions as *T. fusca*, Adams; from which it differs in the more numerous and less regular transverse costæ; its colour is a transparent light-horn, and a narrow rufous band winds round the centre of the whorls. On the body whorl a similar band is situated below the periphery. The columella lip is ruby-tinted.

It agrees in its coloration with *T. festiva*, Angas, but that shell is not coloured on the columella, and its whorls are rounder, aperture wider, and the suture less impressed.

Dimensions of a shell of ten whorls:—Length, ·25; breadth, ·05 inch. The relative proportions of the length to the breadth are in *T. erubescens* 40 to 8, and in *T. festiva*, 40 to 15.

Utriculus apiculatus, *spec. nov.* Pl. v. fig. 3.

Similar to *U. eumicrus*, Crosse, but distinguishable by its sunken spire, the papillary apex of which is exserted beyond the level of the body whorl. The anterior extremity of the shell is more gradually tapering, and the shoulder of the body whorl is less abruptly arched, consequently *U. apiculatus* is more fusiform than its ally. It is also much larger.

DESCRIPTIONS OF TWO NEW MARINE GASTEROPODA FROM SOUTH AUSTRALIA.

Trochocochlea chloropoda, *nov. spec.*

Animal like *T. striolata*, but the under side of the foot is green, and the muzzle and upper side of foot is black.

Shell like *T. constricta*, but without longitudinal plications and sutural constrictions; very thick. Colour, yellowish-white or grey, with surface marked with curved striæ of growth, and under the lens with numerous longitudinal striæ.

Outer lip thin, broadly bevelled on the inner side, of a black colour; perlaceous interior with nine longitudinal, narrow, roundly elevated porcellanous ribs; columella, white, broad, and arched; under side of body whorl black.

It is of the same size as *T. constricta*, and aged examples have the elongate-turbinate shape, as is the case with those of that species.

Habitat and Station.—On rocks below tide marks, Coymbra, Head of the Bight, and near Wilson's Bluff. (*Tate*, many examples.)

ETHALIA (?) CANCELLATA, *nov. spec.* Pl. v. figs. 11a 11c.

Shell lenticular, obliquely-depressed; spire very slightly raised; hyaline, upper and under surface transversely striated and cancellated by longitudinal striæ (the latter vary much in strength, and in some specimens are obsolete); whorls embracing, three and a half; suture deep and narrow, bordered by an opaque white band; body whorl much larger than preceding one, that of the adult shell enveloping the spire. Aperture oblique, crescent-shaped, broader than high. Base flattish or slightly convex, but concave around the umbilical region. Columella broadly thickened, excavated, and spread over the umbilical region to form a small, round, depressed callosity.

Major and minor diameters—·085 and ·065 inch.

Habitat.—Shell sand, Holdfast Bay, St. Vincent's Gulf; Streaky and Fowler's Bays in the Great Australian Bight, *common* (Tate).

The species may be described in brief as a lenticular hyaline *Rotella* with a cancellated sculpture. So far it would seem to fall in with Adams's genus *Ethalia*, whilst the thin callous extension of the body whorl over the spire indicates a relationship to *Teinostoma*; but as the latter genus was founded for the reception of rotelloid shells with distorted body whorls like *Cyclops* and *Streptaxis* I prefer to assign the new shell to the former genus.

Angas has recently described a turbinated *Ethalia (E. Brazieri)* from New South Wales; *E. Tasmanica* is not only questionably Australian, but its generic position is doubtful. The genus now includes sixteen species, all of which, with the exception of *E. Brazieri* and *E. cancellata*, inhabit the coasts of Japan, China, and Mexico.

Explanations to Plate V.

Fig. 1 Helix Nullarborica; *a.* side view; *b.* basal aspect, *nat. sizes.*

Fig. 2. Helix subsecta; *a.* side view; *b.* basal aspect, *slightly enlarged.*

Fig. 3. Utriculus apiculatus, much enlarged.

Fig. 4. Bulimus sinistrorsus, *much enlarged.*

Fig. 5. Lepton trigonale, magnified.

Fig. 6. Zenatiopsis angustata; *a.* exterior of a right valve; *b.* interior of a portion of left valve, *nat. sizes.*

Fig. 7*a.-b.* Plecotrema ciliata, much enlarged.

Fig. 8. Pythina gemmata, magnified.

Fig. 9. Lepton crassum, much enlarged.

Fig. 10. Turbonilla erubescens, much enlarged.

Fig. 11. Ethalia cancellata, *a.-c.*, magnified views.

Fig. 12. Lepton planiusculum, enlarged.

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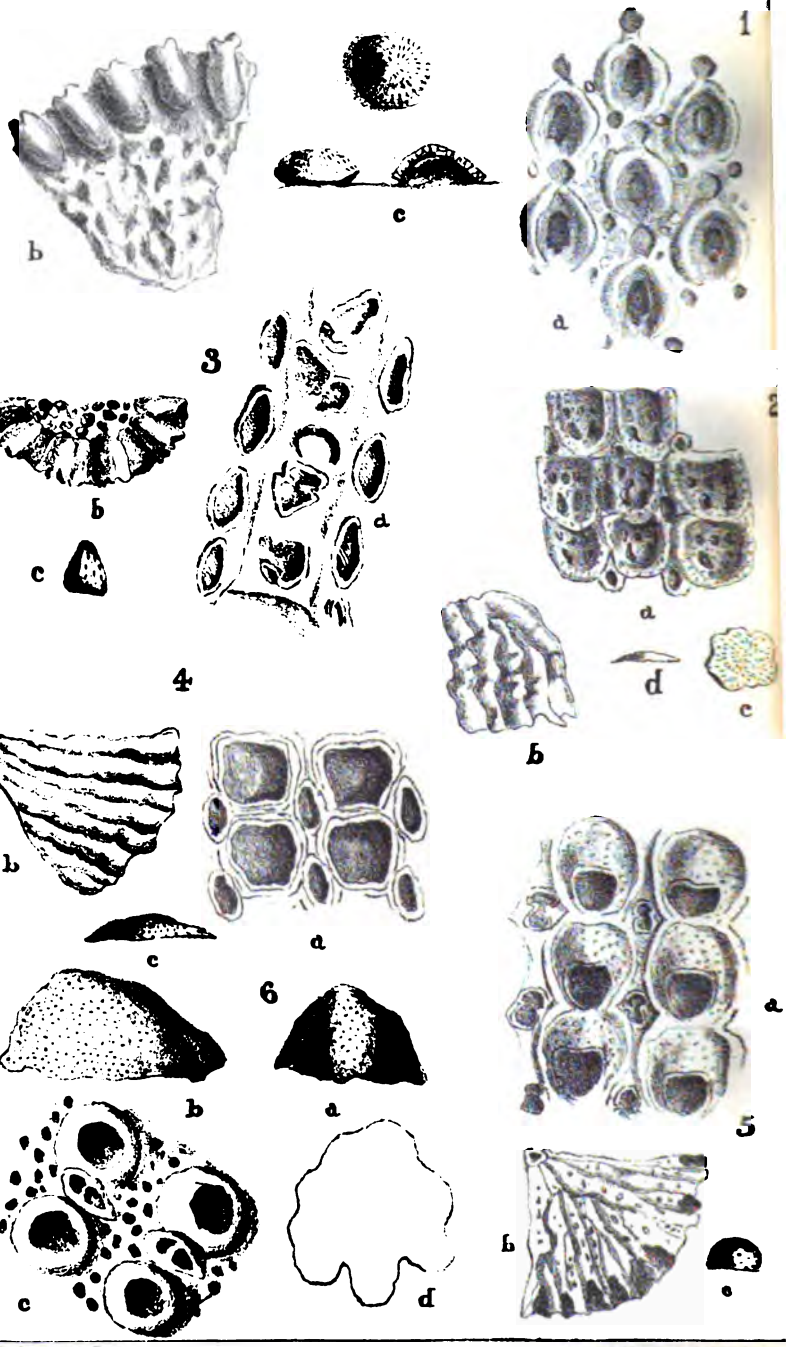

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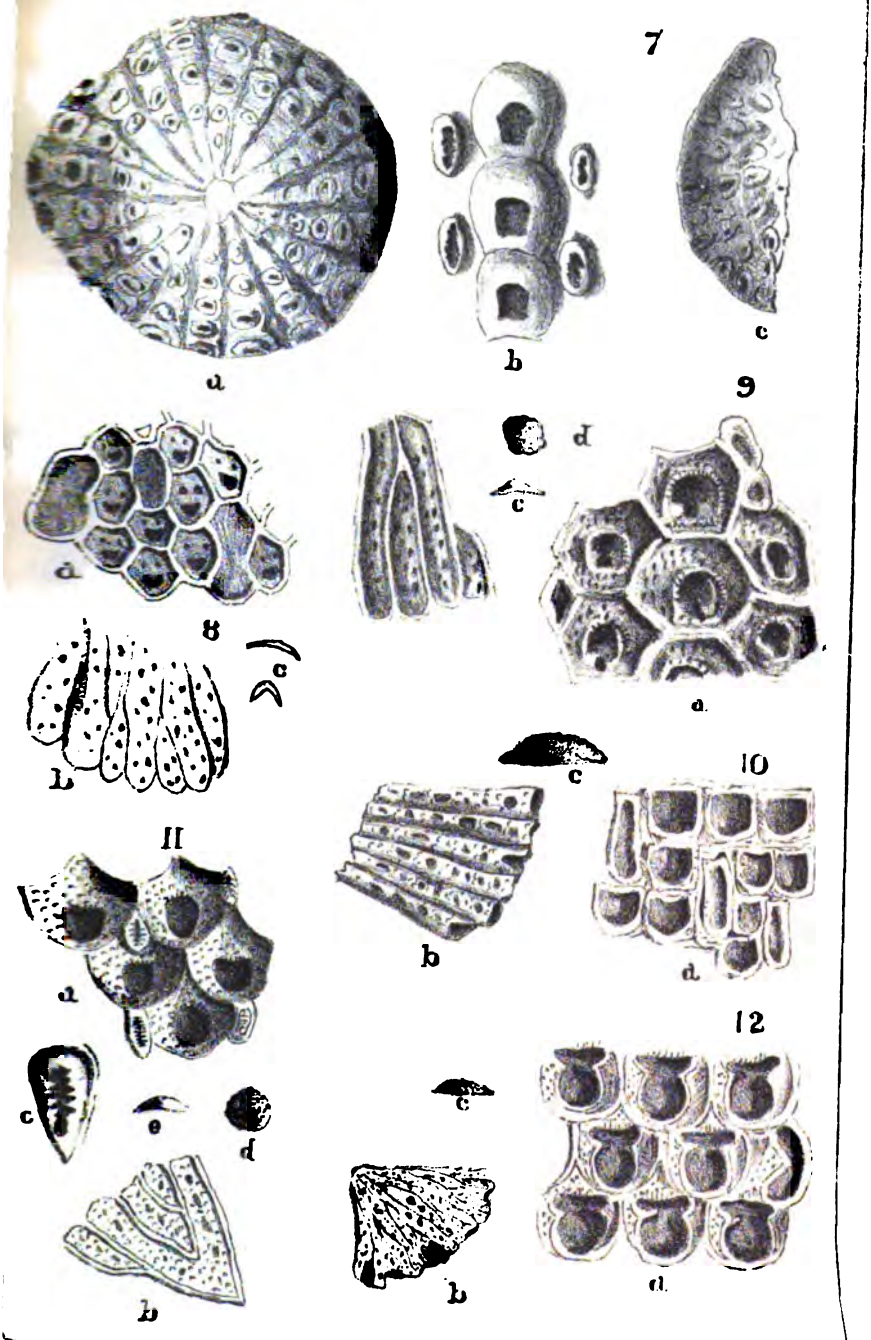

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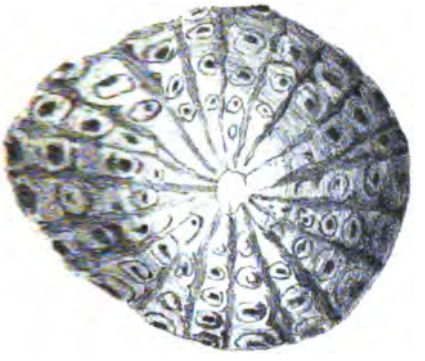

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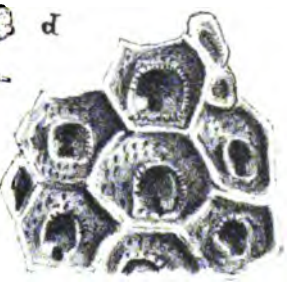

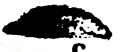

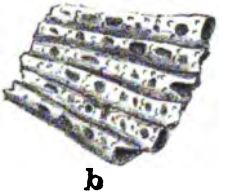

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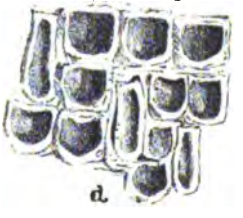

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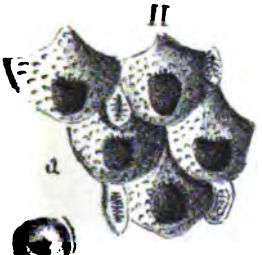

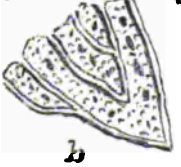

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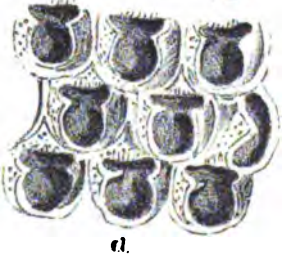

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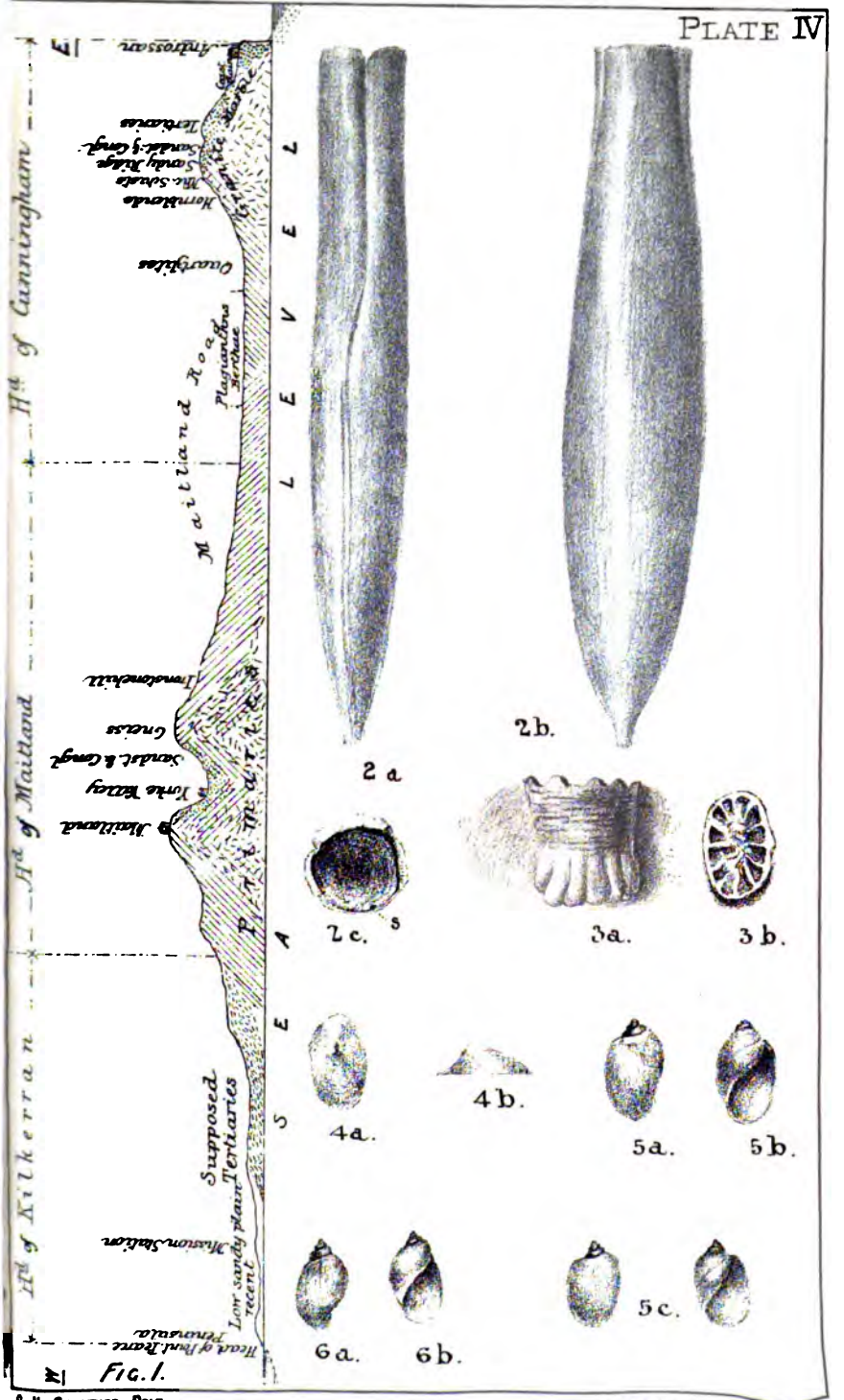
PLATE IV



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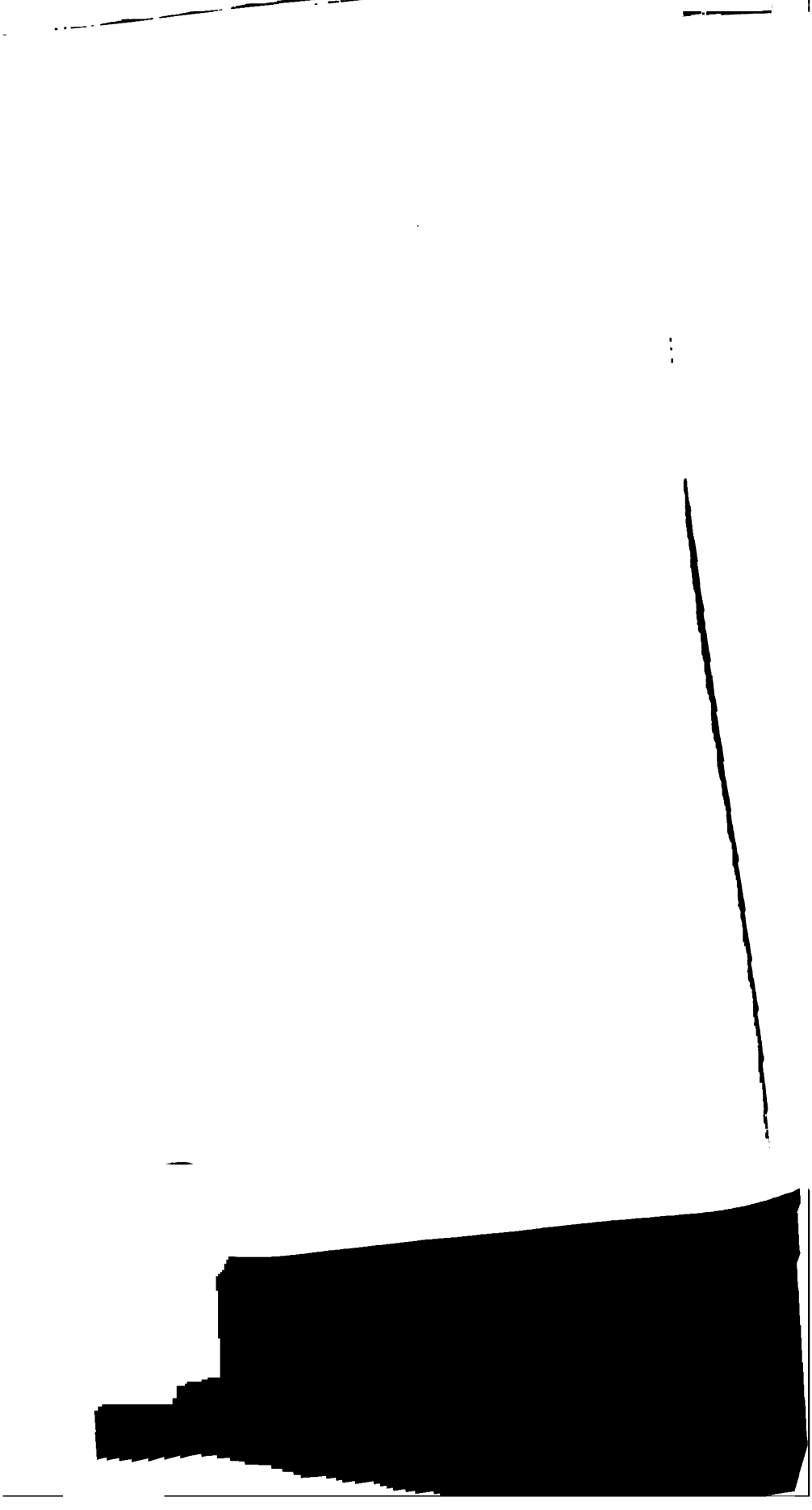

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PLATE VI

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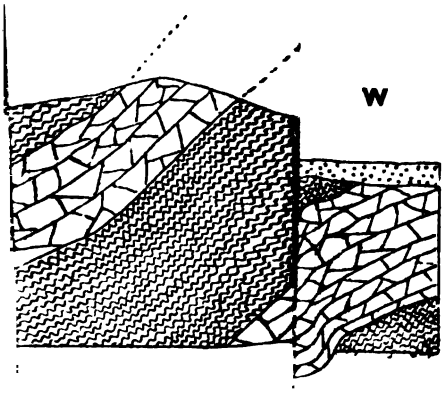

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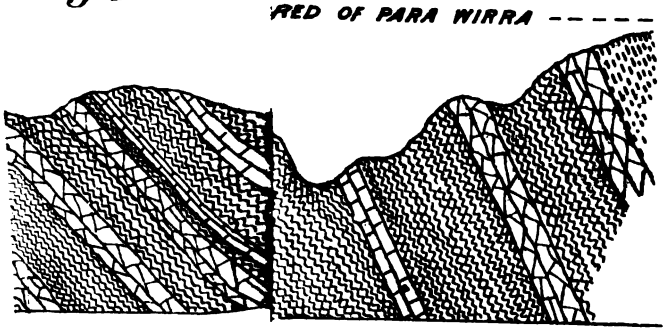

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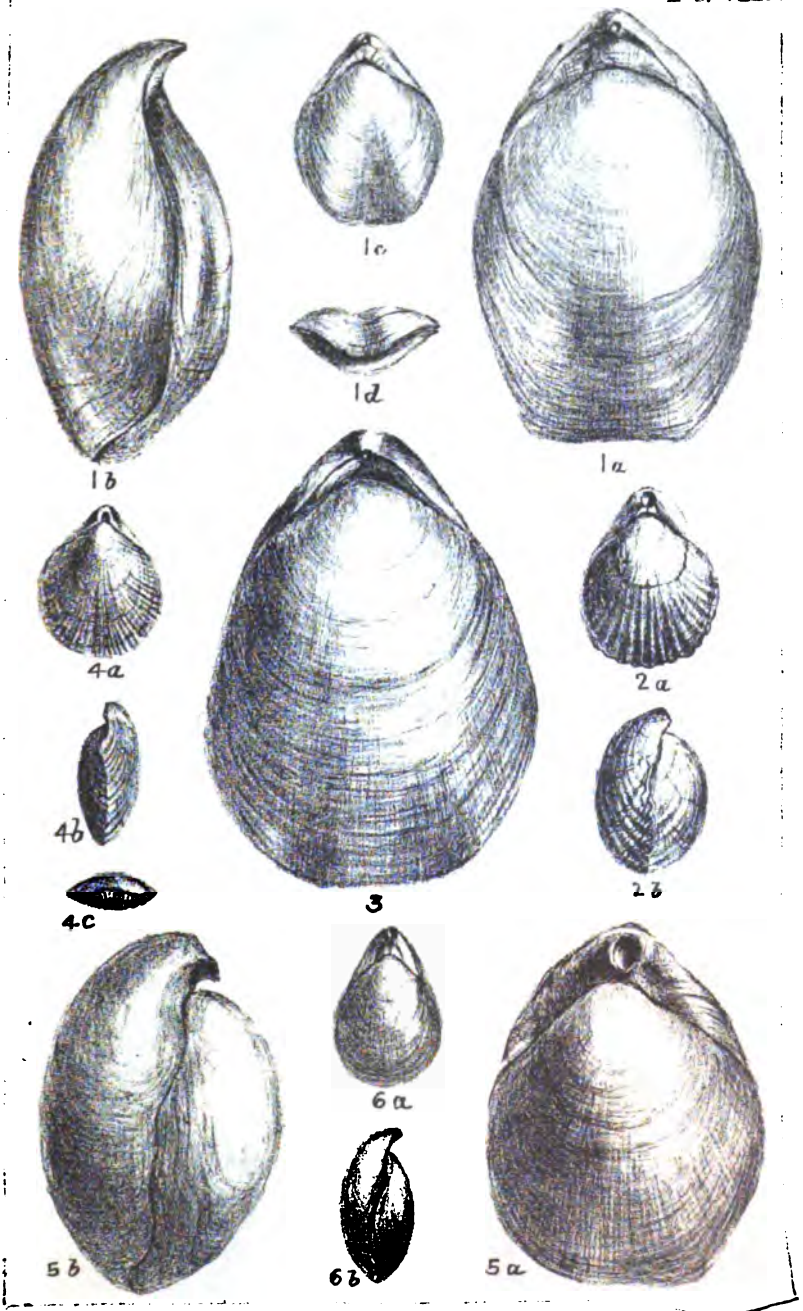

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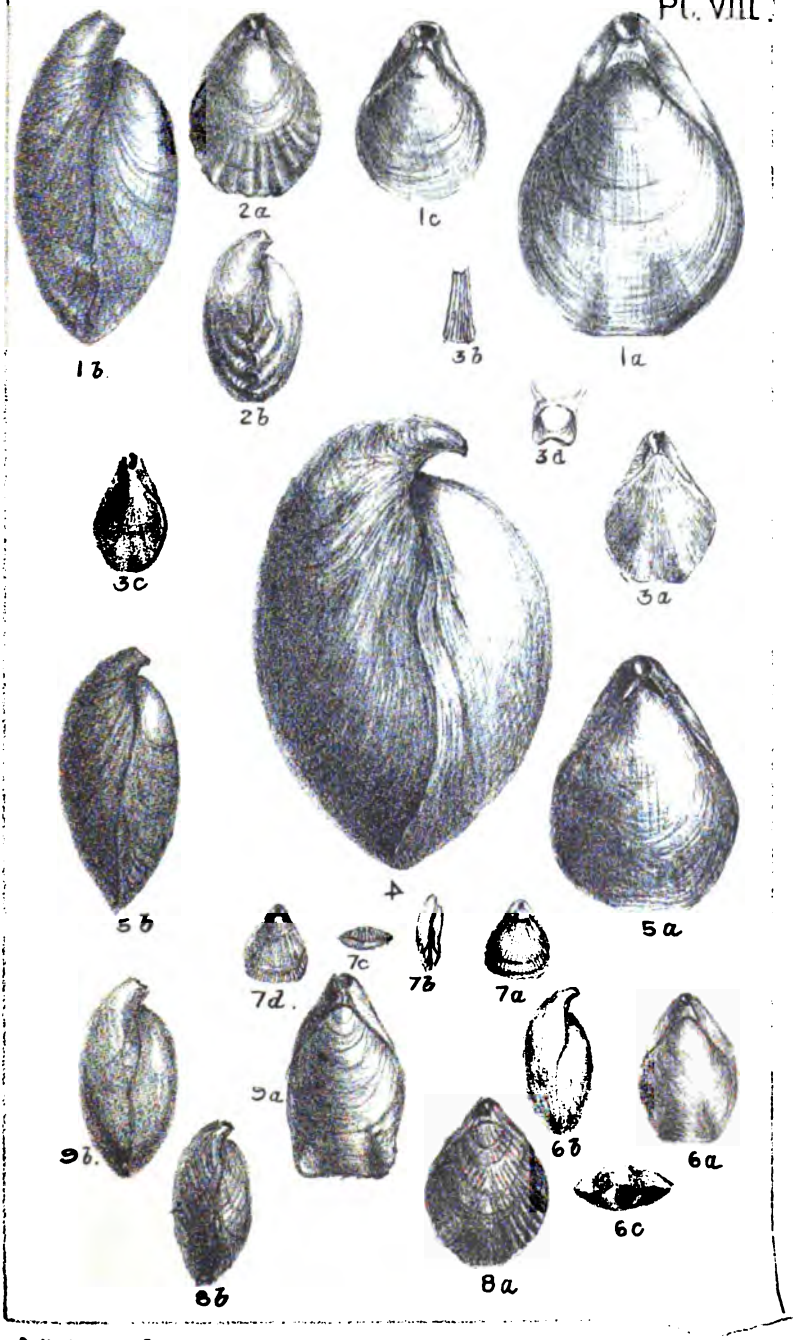

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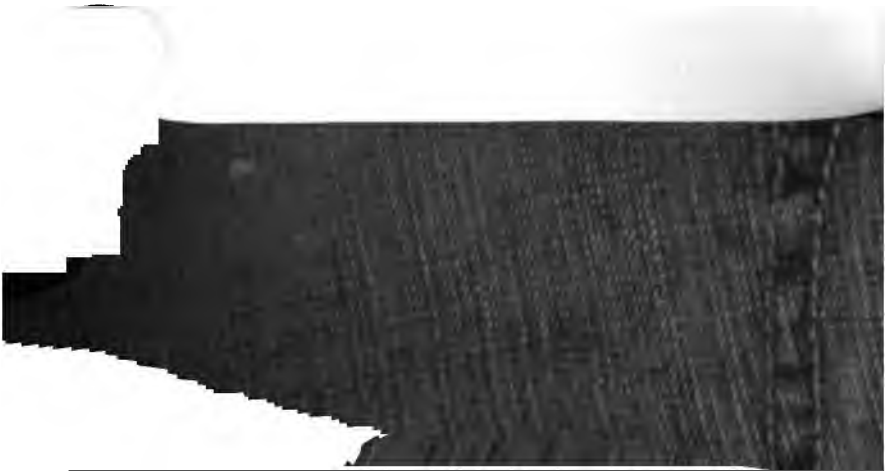

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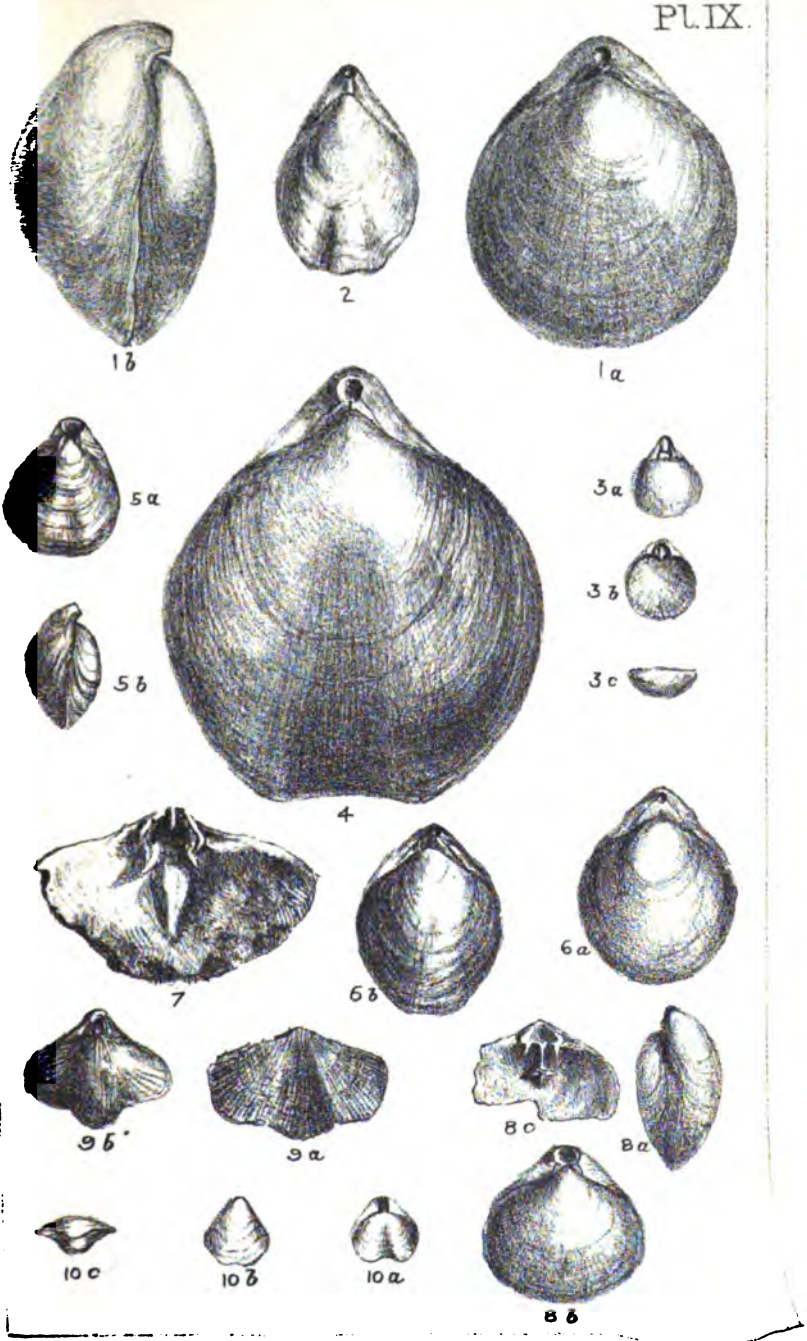

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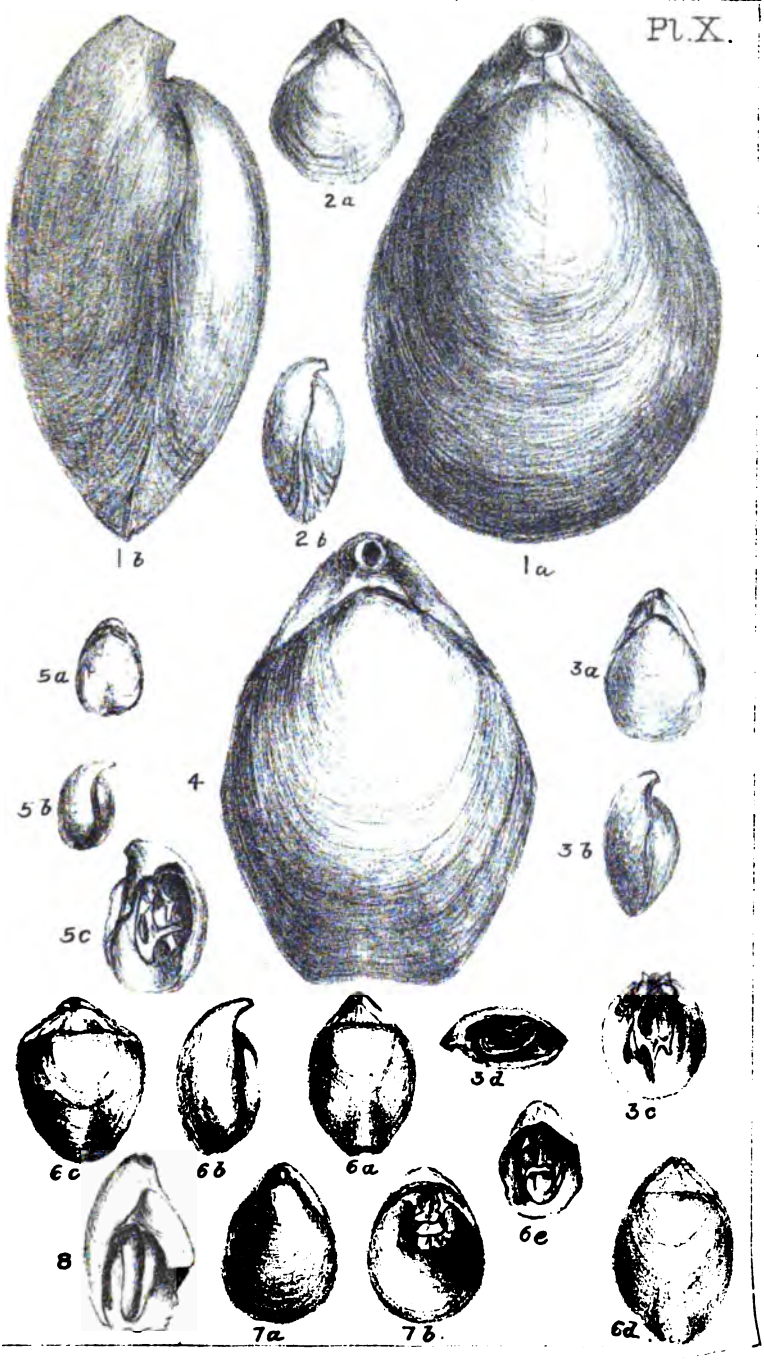

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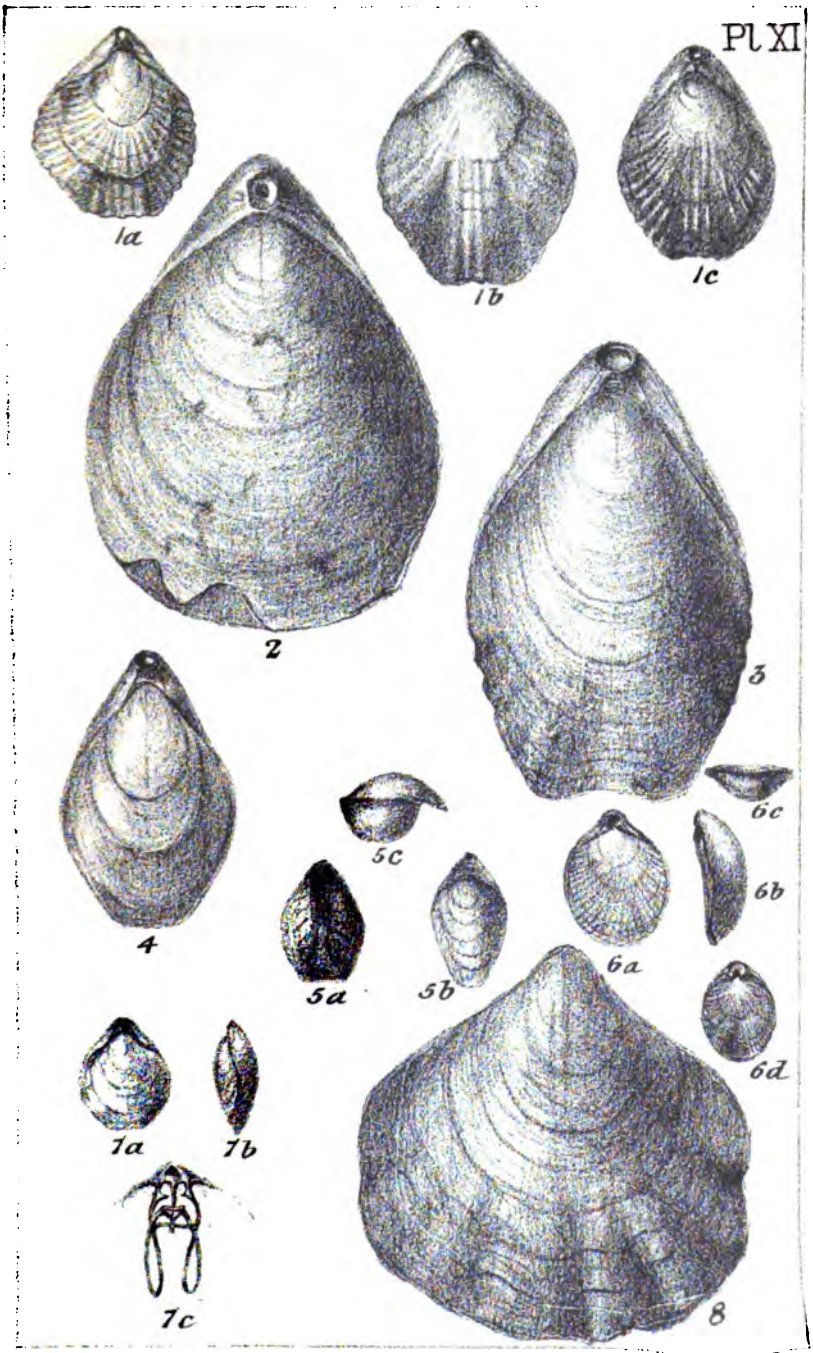

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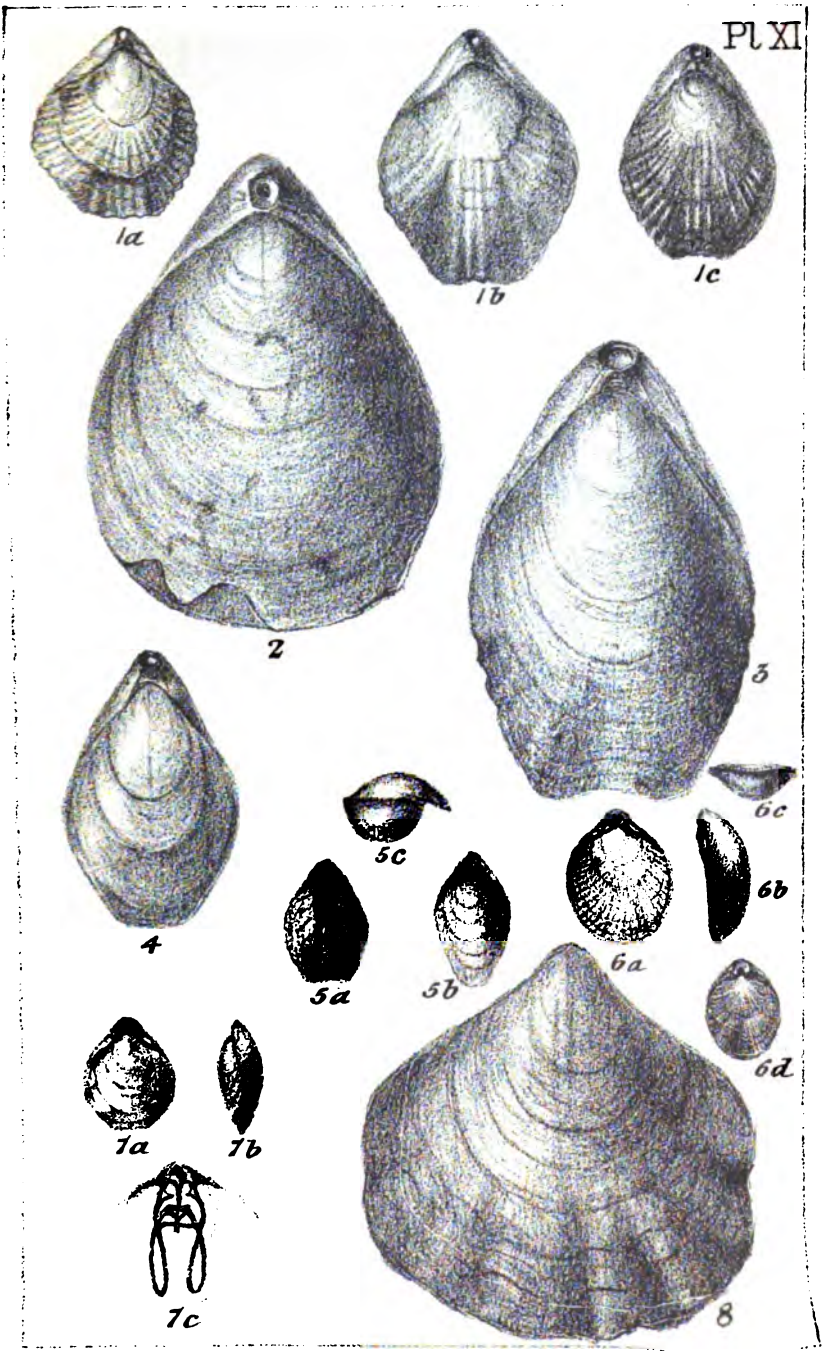

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NOVEMBER 2ND, 1880.

Those marked (F) were present at the first meeting when the Society was founded. Those marked (L) are Life Fellows. Those marked with an asterisk have contributed papers.

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FELLOWS.		
*Adamson, D. B.	Angas-street	1807
Addis, W. L.	Currie-street	1879
Angas, J. H.	Collingrove, Angaston	1874
Biggs, Col. J. H.	Edwardstown	1878
Brunskill, George, J.P.	Morgan	1878
*Chalwin, Thomas	Currie-street	1877
Chapple, F., B.A., B.Sc.	Prince Alfred College	1876
Cleland, R., M.D.	Parade, Norwood	1879
*(L) Cooke, E., M.P.	South-terrace	1876
Cox, W. C.	Buxton-street, North Adelaide	1880
Crawford, F. S.	Surveyor-General's Office	1865
*Davenport, S.	Beaumont	1856
Davidson, Rev. Professor, University of Adelaide	Jeffcott-street, N. Adelaide	1876
Dobbie, A. W.	Gawler-place	1876

Duffield, W.	Gawler	1859
Elder, Sir Thomas	Grenfell-street	1871
*Fletcher, Rev. W. B., M.A., ..	North-terrace, Kent Town ..	1876
Gall, D.	Tynte-street, N. Adelaide ..	1865
Gaze, W. H., M.D.	Parade, Norwood	1880
Giles, E. W.	Government Offices ..	1877
*(r) Gosse, William, M.D., F.R.C.S.	North-terrace	1853
Gosse, Chas., M.D.	North-terrace	1877
*Hamilton, George, Commissioner of Police	Adelaide Club	1868
Harrold, Arthur L.	Hindley-street	1876
Harry, Thos.	Exchange	1878
Hay, Hon. Alexander, M.L.C. ..	Beaumont	1861
Hickson, R., M.I.C.E.	Semaphore	1876
*Hill, W.	Kensington-road	1874
Hopkins, Rev. W.	Glenelg	1880
Hull, W. B., C.E., Assistant Hydraulic Engineer	Hydraulic Engineer's Office ..	1874
Hullett, J. W. H., C.E.	Port Augusta	1876
*Ingleby, R., Q.C.	King William-street ..	1861
Johnson, J. A.	Alfred Chambers, Currie-street	1875
*Joyce, J. F., M.D.	South-terrace	1880
*(r) Kay, R., Secretary South Australian Institute	College Town	1853
Knevett, S.	Carrington-street	1878
*Laughton, E.	Currie-street	1874
*Lloyd, J. S.	Lefevre-terrace, N. Adelaide ..	1856
*Macgeorge, Jas.	King William-street ..	1855
Madley, L. G., Principal of Training College	Moonta-street	1879
Magarey, A. T.	Barton-terrace, N. Adelaide ..	1878
*Magarey, S. J., M.B.	North-terrace	1874
Mayo, G., M.D.	Morphett-street	1853
Mayo, G. G., C.E.	Engineer-in-Chief's Office ..	1874
(L) Murray, David	Hutt-street	1859
Nesbit, E. P., Jun.	King William-street ..	1875
Nesbit, W. P., M.D.	North Adelaide	1880
*Ponton, T. G., F.Z.S.	.. .. ..	1877
Rees, John, M.D.	Port-road, Hindmarsh ..	1880
Rees, Rowland, M.P., C.E. ..	Waymouth-street	1874
Russell, W.	Commercial-rd., Port Adelaide	1879
*Rutt, Walter, C.E.	Engineer-in-Chief's Office ..	1869
*Schomburgk, R., Doctor Ph., &c. Director	Botanic Gardens	1865
*Smeaton, T. D.	Bank of South Australia ..	1857
Smith, R. Barr	Torrens Park, Mitcham ..	1871
Smith, William, C.E.	Hydraulic Engineer's Office ..	1880
Sparks, H. Y.	Glenelg	1878
Strother, C. H., C.E.	Engineer-in-Chief's Office ..	1880
Stuckey, J. J., M.A.	Victoria Chambers, King William-street	1878
*Tate, Prof. Ralph, F.G.S., University of Adelaide	Buxton-street, N. Adelaide ..	1876
Telfer, W.	Wallaroo Hospital	1880
Thomas, J. Davies, M.D. ..	North-terrace	1877
Thomas, R. G., Sec. of Board of Health	Unley	1877
Thow, W., Locomotive Engineer ..	S.A. Railways	1878

Todd, Charles, C.M.G., F.R.A.S., M.S.T.E., Postmaster-General, Observer, and Superintendent of Telegraphs	Observatory	1856
Tomkinson, S.	Mount Lofty	1876
Townsend, W., M.P.	King William-street ..	1878
Umbehaun, C.	General Post Office ..	1879
*Vereo, Joseph C., M.D.	Wellington-square, N. Adelaide	1878
Vickery, G.	Meadows	1868
Ware, W. L.	Victoria Chambers, King William-street	1878
*Waterhouse, F. G., C.M.Z.S., &c., Curator of Museum	S. A. Institute	1859
Way, His Honor, S. J., C.J. ..	North Adelaide	1859
Way, E. W., M.R.C.S.	North-terrace	1878
Wragge, C. L., F.R.G.S.	Care of R. Ingleby, King William-street	1877
Wyatt, Wm., M.D.	Burnside	1859
	ASSOCIATES.	
Holder, Sydney E.	Parade, Norwood	1880
Rogers, R. S.	Bailey's Gardens, Hackney ..	1880
*Smeaton, Stirling	Menindie	1878

RULES.

WHEREAS "The Royal Society of South Australia" is incorporated with the South Australian Institute, under the provisions of the South Australian Institute Act, 1863, and it is desirable to consolidate and alter the Rules and Regulations at present existing, it is therefore agreed that the Society shall be governed by the following Rules and Regulations, to the exclusion of all previous Rules and Regulations:—

1. The title of the Society is "THE ROYAL SOCIETY OF SOUTH AUSTRALIA."

2. The objects of this Society are the diffusion and advancement of the arts and sciences, by the meeting together of the members for the reading and discussion of papers connected with the above subjects, and by other approved means.

3. The Society shall consist of the present members, and of such persons as shall be hereafter elected members.

4. The members shall be classed as follows:—Fellows, Honorary Members, Corresponding Members, and Associates, all of whom shall be elected by ballot.

5. The Sovereign shall be the Patron, and His Excellency the Governor of South Australia for the time being shall be requested to be the Vice-Patron of the Society.

FEES.

6. Fellows shall subscribe £1 1s. per annum, payable in advance on the 1st day of November to the Honorary Secretary.

7. A Fellow may at any time compound for future annual contributions, that of the current year exclusive, by the payment of the sum of £10 10s.

8. Fellows elected during the first half of the financial year shall, within one month after election, pay the full annual subscription of one guinea; but if elected during the second half of the year, they shall pay the sum of half a guinea only as subscription for the remainder of the financial year.

9. Any person who has not paid the year's contribution on or before the 1st day of January shall be liable to have his name removed by the Council from the list of members of the Society; provided always, that written application for the same shall first have been made by or on behalf of the Treasurer; and pro-

vided also, that the Council shall have power to restore the defaulter's name at his request, and after payment of arrears.

Election of Fellows.

10. Every election of a Fellow into the Society shall take place at an ordinary meeting only.

11. Every candidate for admission into the Society must be recommended by two members. The certificate setting forth the names, address, and occupation of the candidate, with the names of his proposer and seconder, shall be sent to the Secretary, and shall be read at a meeting of Council, and also at the following meeting of the Society, and the ballot shall take place at the next following ordinary meeting of the Society.

12. The election of Fellows shall be by ballot, one negative in six excluding; and no candidate having been excluded shall be again proposed for admission during the current year.

13. Persons elected shall have immediate notice thereof transmitted to them by the Secretary, accompanied by a copy of the Rules.

14. Fellows shall have a right to vote at all meetings and to propose candidates for admission into the Society and into the Council of the Society, subject to the Rules touching the election and constitution of the Society. They shall be eligible to be members of the Council, shall have access to the Library, and shall be furnished with a copy of any transactions, proceedings, or journal which may be published by the Society.

Honorary and Corresponding Members.

15. The Honorary Members shall be persons distinguished for their attainments in science, literature, or art.

16. The Corresponding Members shall be persons residing beyond ten miles from Adelaide, who, by furnishing papers or otherwise, may have promoted the objects of the Society.

17. Every person proposed as an Honorary or Corresponding Member shall be recommended by the Council, and be balloted for as in the case of Fellows.

18. Honorary and Corresponding Members shall be exempted from payment of fees; they may exercise the privileges or perform the duties of Fellows, except that they shall not vote or otherwise interfere in the business of the Society, or hold office or seat on the Council.

Associates.

19. Associates shall consist of young men of not more than 21 years of age, and of ladies.

20. Associates shall subscribe 5s. per annum, payable in advance on the 1st day of November, to the Honorary Secretary.

21. The election of Associates shall be after the same manner as in the case of Fellows.

22. Any Associate failing to pay his or her subscription within one month of notice of election, or who shall be three months' in arrear with his or her subscription, shall cease to be an Associate.

23. Associates shall enjoy all the privileges of Fellows except those of taking part in the management of the affairs of the Society, of voting, and of introducing visitors.

24. Any Associate shall be entitled to become a Fellow of the Society at the first ordinary meeting following the receipt of his application for Fellowship.

Local Correspondents.

25. Local Correspondents shall be persons willing to co-operate with the Society in recording Natural Science phenomena in this province, and shall be appointed by the Council. Such Correspondents shall not exercise the privileges of members, but shall be entitled to a copy of all approved communications from the Local Correspondents, which may be published by the Society.

Meetings.

26. Meetings of the Society shall be convened by circular to the members resident in the colony. The circular shall state the subjects to be brought before the meeting, the names of the candidates for membership, and any notice of motion.

27. Meetings of the Society to be held on days to be fixed by the Council; and as far as practicable one meeting shall be held in each month. Each meeting to commence at half-past 7 o'clock p.m.

28. The President, or in his absence one of the Vice-Presidents, shall take the chair; and in the event of the absence of all the above, the members present shall elect a Chairman.

29. The business of the Society's meetings shall be transacted in the following order, unless it be specially decided otherwise:—

I. The reading and confirming the minutes of the last meeting.
II. The nomination of candidates for membership and the election of members.
III. Vacancies among officers, if any, to be filled up.
IV. The transaction of the ordinary business.
V. Motions to be considered, and notices of motion for next meeting to be read.
VI. The consideration of any special matters which members may desire to bring forward subject to the ap-

proval of the chairman obtained before the commencement of the meeting.

VII. At 8 o'clock the paper or subject notified in the circular shall be read.

30. Any Fellow shall be allowed to introduce two visitors upon entering their names in the Visitors' Book. But no visitor shall speak at a meeting of the Society unless specially invited to do so by the Chairman.

31. No paper shall be read at any meeting which has not been previously notified to the Council.

32. Every paper read before the Society shall be the property thereof, and immediately after it has been read shall be delivered to the Secretary and shall remain in his custody.

33. An annual general meeting of the members duly convened by circular shall be held in the month of October at half-past 7 o'clock in the evening, on such day as the Council may appoint. In the event of less than ten Fellows being present, it shall not be lawful for the meeting to proceed to business except for the purpose of adjournment, and the meeting shall stand adjourned to a day and time then resolved upon.

34. At the adjourned meeting the Fellows then present may proceed to business although ten Fellows may not be present.

35. The Council shall call a special meeting of the Society on receiving a requisition in writing, signed by ten Fellows of the Society, specifying the purpose for which the meeting is required, or upon a resolution of its own. No other business shall be entertained at such meeting. Notice of such meeting, and the purpose for which it is summoned, shall be sent to every member at least seven days before the meeting. Ten Fellows to form a quorum.

36. One Fellow, not being a member of the Council, shall be chosen at the meeting of the Society next before the month of October in each year as auditor of accounts and balance sheet of the Society, and shall examine and certify the same prior to the meeting in October.

The Council.

37. The officers of the Society shall be a President, two Vice-Presidents, a Treasurer, and a Secretary, who, with four other members, shall constitute the Council.

38. The Council, on its first meeting, shall appoint one of its members to represent the Society at the Board of Governors of the South Australian Institute, and one to act as Director of the Natural Science Correspondence Department.

39. The Council shall have the management of the affairs of the Society.

40. The Council shall meet once in every month for the

transaction of business at such time and place as may be appointed. Special meetings of the Council may be convened at any other time on the authority of the President, or of three members of the Council. Due notice of all Council meetings to be sent to each member.

41. No business shall be transacted at any meeting of the Council unless at least four members of the Council are present; in case of equality of votes the Chairman shall have an additional or casting vote.

42. It shall be the duty of the Council to decide on the papers to be read at the monthly meetings, whether by members or non-members; to determine as to the publication in whole or in part of any paper so read; to prepare a report of the proceedings of the Society for the preceding year, and a balance sheet of the Society's funds, for presentation at the meeting of the Society held in October; and generally to transact the ordinary affairs of the Society.

43. Any member of Council, personally interested in a question before the Council, shall withdraw during its consideration.

44. Every vacancy in the Council shall be immediately filled up at the next meeting of the Society by election by ballot. The member so elected shall occupy the place of the retiring member.

45. Any member of Council absenting himself from three consecutive ordinary meetings of the Council without satisfactory explanation shall be considered to have vacated office, and the election of a member to fill his place shall be proceeded with in accordance with Rule 44.

Election of Officers and Members of Council.

46. All officers and members of Council shall retire from office annually at the general meeting in October.

47. The officers and members of Council so retiring shall be eligible for the same or any other office.

48. The President, the two Vice-Presidents, the Treasurer, and the Secretary shall be separately elected by ballot (should such be demanded) in the above-named order, and the four vacancies in the Council shall be filled up together by ballot at the general meeting in October.

Secretary.

49. It shall be the duty of the Honorary Secretary to attend and take minutes of the proceedings of the Society and Council respectively; to make the necessary arrangements for meetings; to issue the required notices; to collect the annual subscriptions and to pay them to the Treasurer; to take charge of

all the property under the control of the Society; and generally to transact the ordinary routine business of the Society.

Treasurer.

50. It shall be the duty of the Treasurer to receive all funds belonging to the Society; to pay all accounts approved by the Council; and to render annually an account of all moneys received and expended during his year of office.

Natural Science Director.

51. It shall be the duty of the Director to conduct the correspondence with the Local Correspondents and Natural Science Referees; to report at the ordinary meetings of the Society all useful information therein contained; and to prepare the same for publication, subject to the approval of the Council.

Alteration of Rules.

52. The Rules and Regulations of the Society shall not be altered unless a written notice of motion, signed by not less than five Fellows, be given at a meeting of the Society; and thereupon such motion may be brought forward at the next meeting.

53. Any resolution passed as above altering or repealing the Rules and Regulations of the Society shall be in force until the meeting held in the month of October following; and, if not then confirmed, shall thereafter be held void and of no effect.

ABSTRACT OF

OF

Royal Society of

FOR

ORDINARY MEE

Professor RALPH TATE,

The list of donations to

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Professor TATE said
Weeds in South Aust
sidered the list to be in
been overlooked. Of
of *Diplotaxis*, a *Salvia*
&c. Whilst on the
to such species as *B*
which in his opinion
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Mr. Tepper. He also exhibit
himself from the Lower Silurian
well-preserved head of a trilobi
eyes.

Professor TATE exhibited speci
pelagic mollusc, *Ianthina*, whic
George's Sound, through the kin
The shells were in a fine sta
evidently been taken alive, as th
packed had been stained a ric
matter exuded from the animal.

Mr. T. D. SMEATON exhibit
insects which he had received fr
that they were frequently foun
these insects he had found to be
with antennæ. The eye was dep
body had a springing motion, bu
that the animal was not a *Podur*

The following communication
By Mr. J. G. Otto Tepper. (Se

ORDINARY MEETING,

Professor RALPH TATE, F.G.S.

Dr. W. L. Cleland was elected

The list of donations to the Li

NOTES AND

Professor TATE read portions
Mueller in reference to the indi
tralia, and he advised that the S
Mueller to prepare a revised lis
mation, especially in regard to l
"Flora Australiensis" was defic

Mr. MOLINEUX exhibited speci
found abundantly on all kinds o
Town. The perfect insect ha
wingcases; the larvæ, in its fir
characteristic frothy liquid, but
with a downy material like that

Mr. THOS. D. SMEATON exhib
large number of plants collected

The following communication

Uses of Wattle Bark (*Acacia pycnantha*)," by Dr. S. J.
Magarey:—

[ABSTRACT.]

The golden or broad-leafed wattle (*Acacia pycnantha*) **is found in abundance in** this colony, especially upon undulating hills, **thriving upon almost any soil, but preferentially on that of a light sandy nature.** It exudes an **abundance of gum, and affords what is now** acknowledged **to be "far** and away **the most valuable tanning** bark in the **world."** Its higher branches **and twigs yield some** of the **best bark.** The sap is up during **September to December, and** hence these are the best months **for collecting the bark,** whether for economic or medicinal pur- **poses. It is acknowledged** that the tanning properties improv- **if the bark be kept for** some little time. The wattle is at **prime when it is from** eight to ten years, and in the hand **Mr. Bosisto** yielded as much as 45 per cent. of **extractive.** it has in medicine is as an *astringer* **corrugates** Its main use the papillæ of the tongue, and imparts a de **astringent** taste, it coagulates albuminous fluids, an **contraction** of muscular fibre. Its primary effect whe **to** a mucous membrane is to diminish secretion; ar **no** doubt that by diminishing the relaxation of the **intestines** it promotes digestion. It ranks high **vegetable** astringents, and the very finest qu **catechu** hardly exceed that of our wattle. As **has** been exceedingly serviceable to me in my **infants** and children. A form of diarrhœa e **amongst** them, and very fatal, seems to b **with** this remedy than with any with wh **It** occurs most frequently during dentiti **months,** especially in infants brought **under** the most favourable circumstar **nursing.** The stools are exceedingly **green** or almost colourless, not al **But** if unchecked, the child passe **restless** fretful disposition into t **cephalus.** I usually order an i **house,** by putting a piece of b **to** one drachm in a breakf **water,** covering it and lettir **then** direct a teaspoonful t **oftener.** For adults th **Occasionally** I have fin **with** sugar of milk. I **more** satisfaction t **notion** that it is un **inclined** to think t

although it is better not to stop it suddenly. The infusion of *Acacia pycnantha* does not usually immediately arrest the diarrhœa. Errors in dieting must, of course, be corrected, and attention to hygienic requirements is necessary *in all* cases, or no remedy will be successful. In the winter-diarrhœa of infants I have not found the remedy to be so efficacious. It is useful in other forms of diarrhœa, but I do not think it should be used in any inflammatory conditions. In dysentery its effect is not so marked, and though useful, I think we have better remedies. In sore eyes, catarrhal ophthalmia, it is a favourite remedy in the country. I have used it with success in such cases. In a case of granular lids I think the patient benefited from its use, although under ordinary treatment his disease had remained stationary. *In true diphtheria* it is unreliable; but in those cases where there is a deposit upon the tonsils, diphtheric in character, but unaccompanied by the characteristic symptoms of blood-poisoning, it seems when used as a gargle or as a glycerole painted upon the pharynx and tonsils to be very useful. In sore throat, simple angina, it is valuable. It makes a fine gargle for relaxed throat, and more especially for that form of sore throat which is rendered less painful by eating a meal. I have mixed two drachms of the tincture with an ounce of glycerine, and have found a useful application for otorrhœa (running at the ears), for chapped lips, and slight fissures of various kinds. I have used it also in ozœna. It is very useful for sore nipples in nursing mothers. I do not think it is so useful in this form as the glycerine of tannic acid, but it makes an excellent substitute for it. In sweating feet, it is a good plan to steep them occasionally in a strong infusion of the bark. In typhoid fever it has on one or two occasions seemed to check what appeared to be an incipient attack. But we have a much better remedy in baptisin. I used it in one case of typhoid fever for hæmorrhage from the bowels with apparent success. The remedy ought to be useful in hæmoptysis (spitting of blood), hæmatemesis (vomiting of blood). It deserves a trial in all discharges from a mucous membrane, as leucorrhœa, &c., &c. I have been informed that the gum of the wattle, taken internally, is a useful remedy for piles. It is used in veterinary practice in the country for wounds and raw shoulders. I have tried it occasionally, and feel encouraged by the results. It is more generally of advantage in indolent ulcers and wounds that want a little gentle bracing-up. It is a good remedy for eczema where there is much weeping, and is really admirable for intertrigo (that is, the chafing of the skin of an infant) that occurs in the folds of the skin and about the nates. It ought to be useful for the arrest of venous hæmorrhage from the surface, but I have not yet given it a

by which it was thought those objects could best be obtained. No response seemed to have been given to the appeal. Now that the Society was better circumstanced, it should give effect to the abstract resolutions proposed in 1872. The time had arrived when the Society should make strenuous efforts in the direction indicated. By its widespread publications it offered to provincial workers a channel of intercommunication, and was prepared to adequately illustrate all original papers, when necessary, by lithographic plates. The healthy vigour of the Society must be to a large extent sustained by the efforts of those occupying themselves with the more technical aspects of science, but such workers needed coadjutors. The Society should endeavour to add recruits by stimulating a love for scientific pursuits. He had been brought to think deeply on the subject from discussions in the daily papers, originating in some remarks he made at the last meeting of the Society touching the occurrence of certain introduced plants into the colony. Regarding that matter, he read a letter from Mr. E. S. Wigg to the effect that he had been much amused at the correspondence in the *Register re* the *Leontodon taraxacum*. He introduced the seed twenty-five years ago, and gave Mr. Greenham, of Third Creek, some, who raised plants, and from him it had gone from Payneham to Bridgewater. He had grown it in his garden at North Adelaide for twenty-five years, chiefly for his cage-birds, who were very fond of it. He had been rather amused at Mr. McEwin's argument that Professor Tate must have made a mistake, as he "had not seen the plant in the colony." The remarks he (Professor Tate) had made had elicited unrecorded facts from no less than five individual observers, and proved that no large inquiry like that of the distribution of our alien plants could be exhaustively undertaken by one person acting independently. He proposed that observers should be encouraged to correspond with the Society; facts should be recorded, published, or reserved; there should be a Committee of Reference, and a Corresponding Secretary might be appointed to undertake duties connected with the reception of facts and specimens. If the scheme worked well it might be advisable to add to the Council a Director. Correspondents known to have facilities for gathering desiderated knowledge should have their attention particularly directed to the points about which more information was desired. For instance, Professor Owen has, for 35 years, been asking for information upon certain points in the generative economy of the *Echnida hystrix;* another question was, whether the porcupine ant-eater, inhabiting Kangaroo Island, was that species. The exhibition of specimens and reading of notes referring thereto was one means whereby members might be interested in

natural history work. Another stimulant would be excursions to the most interesting localities for investigating natural history, say two each year. Prizes for the best collection of scientific objects or the best paper might be made.

Mr. SMEATON said he cordially agreed with the scheme.

Mr. MOLINEUX said with regard to the porcupine ant-eater at Kangaroo Island, it was most advisable that the nature and habits of the animal should be clearly known, and that there was so little information on the point was due perhaps to the fact that there were few scientific men on the island. The animal was so common there that its fat had been used for slush-lamps.

Mr. SMEATON said the information might be obtained from Mr. Wilson, who was an old resident of the island, and was a very observant man.

Dr. GOSSE suggested that the Secretary might communicate with Mr. Wilson and get specimens of the ant-eater sent.

Mr. MOLINEUX expressed himself strongly in favour of the Society attempting some such scheme as that proposed by Professor Tate in the cause of science and for the reputation of the colony. In our woods there were animals and insects of which it was most important that some knowledge should be obtained. There used to be a small marsupial on the Adelaide Plains years ago which had now disappeared, and Mr. Waterhouse, to whom he spoke, said he knew nothing of such an animal, but he (Mr. Molineux) remembered seeing it when he was a boy.

It was resolved that the Council should nominate a Committee to carry out the suggestions made by the President.

ORDINARY MEETING, FEBRUARY 3, 1880.

Professor RALPH TATE, F.G.S., in the Chair.

Mr. W. Telfer, Wallaroo Hospital, was elected a Fellow.

The list of donations to the Library was read.

The HON. SECRETARY read a draft of a letter to the Governor requesting him to forward a petition to Her Majesty the Queen praying her to become Patron, and to allow the Society to be known in future as "The Royal Society of South Australia." The letter and petition were unanimously approved. And it was also resolved to request His Excellency to become Vice-Patron in case Her Majesty assented to the prayer of the Society.

EXHIBITS AND NOTES.

The PRESIDENT reported that in connection with the proposed record of Natural History phenomena he had received several

letters and specimens. For the nature of the exhibits see Miscellaneous Contributions.

Mr. F. G. Waterhouse exhibited a number of fragments of skeletons of various extinct marsupial animals, including Diprotodon australis and Phascolomys gigas, in addition to several others, which had been presented to the South Australian Museum by Mr. R. M. Robertson, of Normanville, who found the first instalment in the bed of the Salt Creek, where they had been laid bare by the action of a freshet. At the first opportunity Mr. Waterhouse visited the place, but found the water too high to enable further search to be carried on; but Mr. Robertson kindly undertook the task of watching for further opportunities, with the result of raking up several other pieces, amongst them being several duplicates, proving that these were the remains not of several species of animals only, but of more than one of each kind. As Mr. Waterhouse was in doubt as to the true character of some of the remains, he forwarded duplicates to Professor Owen, at the British Museum, stating his opinion as to their nature, and received the following letter, confirming his ideas and thanking him for helping the Professor in his researches:—"British Museum, September 17, 1879. Dear Mr. Waterhouse—Accept my best thanks for your letter of June 18, 1879, and continued kind interest in my quest of the extinct mammals of Australia. Your case of fossils duly arrived. They included, as you state, parts of *Diprotodon* and of a gigantic wombat *Phascolomys gigas*. (This is generically distinct from the smaller *Phascolomys*.) The great kangaroo is of the interesting genus and species *Procontodon goliah*. The more fragmentary specimens I have not yet satisfactorily determined, at least as belonging to any species not hitherto known. . . . I am still hoping to get (in spirits) an impregnated uterus of either *platypus* or *echidna*, but at my age (75) I cannot but feel that the day of work is drawing to a close.—With every good wish, believe me most truly yours, Richd. Owen. Mr. F. G. Waterhouse, C.M.Z.S., Curator Adelaide Museum."

A brief discussion followed, the general surmise being that the bones which had been brought to light had not been deposited in the creek, which was not an old one, but had been unearthed by the washing away of the substance in which they lay.

The Hon. Secretary read some notes by Mr. Thomas Burgoyne, of Port Augusta, on "A Marsupial formerly found at Port Augusta," but now extinct there. The animal alluded to he thought was the smallest marsupial in the world. It had been met with on the eastern coast about Port Augusta 25 years ago, and, according to the accounts of the blacks, were

very numerous, and were known as kangaroo mice. The largest specimen did not exceed four or five ounces in weight. The domestic cat had been introduced at the period he had referred to, and the little animal had soon disappeared. He had obtained four or five specimens, but all of them dead; and one live specimen had died in a week from the time he had obtained it before he could observe its habits. It was almost a kangaroo in miniature, with a few differences. It did not move about in daylight, but was to be seen in the evening or at night, when it was seen to be a swift animal for its size. He thought, though it had ceased to exist in his district, it might be found further inland, and that communication with the officers on the telegraph line might result in specimens being procured which he thought would be of value.

Mr. WATERHOUSE said he knew the animal referred to from the description. It was not a marsupial, but a rodent; either *Hapolotus cervinus* or *Hapolotus Mitchelli*.

Paper read:—"On a Census of the Indigenous Flowering Plants of Extratropical South Australia," by Professor Ralph Tate (see p. 46).

ORDINARY MEETING, MARCH 2, 1880.

Mr. F. CHAPPLE, B.A., B.Sc., Vice-President, in the Chair.

Messrs. W. C. COX, H. C. Strother, Dr. J. F. Joyce, and the Rev. W. Hopkins were elected Fellows.

Mrs. Annie Richards, Fowler's Bay; Mr. J. Canham, Stuart's Creek; and Mr. Paul Foelsche, Port Darwin, were elected Corresponding Members.

The list of donations to the Library was read.

The CHAIRMAN said that in order to facilitate the operations of the Society it had been thought advisable to change the name of the Society by adopting the title of the "Royal Society of South Australia." The Secretary would lay the whole matter before them as it stood at present.

The HON. SECRETARY said that he understood that the proper step to take was to forward a memorial to Her Majesty the Queen through His Excellency the Governor. It was advisable that this memorial should be formally adopted by the meeting, and not simply emanate from the Council, although the Council might be acting on the wishes of the members of the Society. He read the memorial which it was proposed to adopt. The prayer of the memorial was that Her Majesty would become Patron of the Society under the new title proposed, and the petition then proceeded to give a brief history of the formation and progression of the Society.

Mr. Todd, C.M.G., suggested that it would be advisable first of all to communicate with the Royal Societies of the neighbouring colonies, and to ask to be furnished with a copy of the memorial adopted by them when they took similar steps.

After a short discussion the matter was postponed.

The Hon. Secretary referred to the fact that forms had been circulated in various parts of the country, to be filled up by the recipients, the information which was sought to be elicited having reference to the sinking of wells and other borings in the colony. He had received a reply from Mr. W. Fowler, of Yaroo, Kulpara, furnishing the required records concerning three of these wells. Mr. Fowler gave their levels above the sea. The depths of the wells were 84, 145, and 165 feet respectively. The shafts all penetrated strata of the same character, and were situated about one mile or one and a half miles from the shores of the Gulf. Brackish water was struck at about the sea-level in each case, but the fluid was not too brackish for stock to use. Mr. Fowler promised to supply any further information that lay in his power, and to present the Society with a specimen of some fossils of mangrove roots found in the sinking of one of the shafts. These fossils were similar to those found some time ago at Port Wakefield. Mr. Fowler described the strata of sand penetrated, and expressed a belief that they rested upon a clay slate.

The following paper was read:—"Notes on the Comet of February, 1880." By Mr. C. Todd, C.M.G. (See p. 19).

An interesting discussion upon what is known of, and what has been speculated concerning comets, followed. Attention was particularly drawn by Mr. Ingleby, Q.C., and other speakers, to the remarkable circumstance that the recent comet did not actually set below the horizon, but faded into blankness as the night advanced, while its tail was still many degrees above the horizon, and questions were raised as to whether the luminosity of comets was self-existent, and internal, or whether it was merely a received and reflected light. Professor Tindall's theory of a body or vapour of great tenuity, made luminous by the operations of actinic rays of light from some light-giving centre, and afterwards being destroyed by the heat rays, was referred to, but Mr. Todd considered that this theory did not satisfactorily account for the curvature of the tail and many other peculiarities observable in comets. His opinion as to the nature of their nebulous light was that it consisted partly of internal and partly of received or absorbed light. Spectrum analysis proved that the nucleus of comets possessed self-luminous vapours, but no experiments with the spectrum had yet been carried out with the tail of any comet.

Mr. Ingleby said the comet did not set, but died away, which made him hold the opinion that the tail was borrowed light. He thought that the consideration of the circumstances of the rapid fading away of the comet might lead to useful discoveries respecting the constituent elements, &c., of these celestial phenomena.

In reply to a question, Mr. Todd stated that the various obstacles in the way of obtaining clear observations of the recent comet had prevented him from being able to calculate its distance from the sun, but, speaking roughly, and by no means committing himself to the statement, he should say the distance was under fifty millions of miles.

Reference was made to the frequent recent occurrence in our skies of large and brilliant meteors, and the theory that showers of meteors usually followed the appearance of a comet was briefly alluded to. A suggestion was made that in the statistical and general records now being compiled by the Society as much information as was possible should be obtained respecting meteoric appearances, and the Secretary promised to note the suggestion.

Ordinary Meeting, April 6, 1880.

Professor Ralph Tate, F.G.S., President, in the Chair.

Dr. John Rees, Hindmarsh, was elected a member of Council in

Mr. A. W. Dobbie was elected a Fellow.

The list of donations to the Library was read.

Notes and Exhibits.

Mr. F. G. Waterhouse, C.M.Z.S., on behalf of
Australian Institute, exhibited land shells from
Islands, presented by John Brazier, Esq., C.M
Fossils, minerals, and shells, presented by
Jewell.

Mr. W. Fowler, of Yarroo, Kulpara, for
of fossil mangrove root, taken from a
about sea-level, in the District of Kulpa
Professor Tate said from what he
could quite believe the plant remai
the land had been elevated above se
Mr. D. Brown, of Port Adelaid
native wooden weapons showin
been forwarded to him from
hazarded the opinion that
practice of sun worship by
Professor Tate exhibi

mented wood implements, received from Mr. Canham, of Stuart's Creek. He rejected the notion that the figures are symbols, and held the opinion that they were intended for ornament. The two specimens exhibited showed a symmetry of pattern of at least three styles, and he said that symmetry is the first aim of barbarous nations in their attempt at ornamentation, whilst symbolic characters are to a very large extent dissimilar. To further speculate on their meaning, he considered, must be labour thrown away, and he very much doubted if they can be regarded as the production of the untutored aboriginal.

Papers read:—1. "Some Remarks on the Late Comet," by Professor H. Lamb, M.A.

[ABSTRACT.]

Professor LAMB, in continuation of the discussion of the previous meeting on Mr. Charles Todd's paper, wished to consider two points only. The first was as to the results of the spectroscopic examination of comets, which he ventured to say was rather inadequately stated on the previous occasion, though that was no fault of Mr. Todd; and the second was as to a theory of comets propounded by Professor Tait, of Edinburgh. By the printed report of last meeting he saw that it had been stated that no very definite results had been arrived at by spectroscopic examination of comets. But since the instruments had obtained their present perfection no comets of very great brilliancy had appeared. When the great comet of 1858 was visible these appliances had not reached a state of perfection. But in 1874-5 had appeared Coggia's comet, and Dr. Huggins had examined it spectroscopically. From the coma he had obtained a spectrum of bright bands. From the nucleus he also got a gaseous spectrum, and the result of his observations appeared to suggest that in comets there is some solid matter, as in the tail, capable of reflecting sunlight, as shown by a continuous spectrum. The gaseous spectrum showed indications of heated gas in portions. The spectrum of bright lines which had been observed was similar to what had been observed in at least one other comet, and the same which was obtained from carbon, which was curious. On examining the spectrum a second time Dr. Huggins found bright lines, showing a shifting of the body, such as was observed in the case of the fixed stars. The theory of comets put forward by Professor Tait, of Edinburgh, was that comets consisted of a mass of stones, which might vary in size. It was strange that this was not put forward before by a Scientific Society or a scientific magazine, where it might have been expected to be found. It was in a lecture delivered to working men, and he had found it in *Good Words*. His idea was that the comet was

a swarm of meteors, and that these changed the appearance of the tail by changing their position towards each other in their orbit, and that when nearest the sun they would have the greatest velocity, and striking together with greatest force developed heat. They had in this the materials of both the continuous spectrum and the gaseous spectrum obtained. The theory was based on facts, and did not appeal to electricity to account for what could not be accounted for.

Mr. CHAPPLE referred to the lightness attributable to comets, and though if they were composed of swarms of stones that they must have considerable weight. He also asked whether much of the light was not reflected sunlight.

Professor LAMB believed it was to some extent, but at the same time it could not be said that it was to any great degree, and there was a good deal of light which belonged to the comet itself. There must, therefore, be heat generated by these individual masses to render them incandescent. The Professor went on to speak of the late comet as having been seen at Buenos Ayres going northward, according to a telegram received at Kiel from Dr. Gould, of the Argentine National Observatory, and hoped in conclusion that when next we had a brilliant comet our Observatory would not be so badly supplied with instruments, or so inadequately provided with a staff, numerically considered. South Australia owed a great deal indirectly to scientific discovery, and while she could not be expected to keep up an establishment such as there was in Melbourne, the requisite instruments should be obtained.

2. "On the Native Plants of Yorke's Peninsula," collected by Mr. J. G. Otto Tepper, F.L.S., named and arrangements revised by Baron F. von Mueller, hon. memb.; and "Remarks on their Distribution," by Mr. J. G. Otto Tepper, F.L.S., corresp. memb. (See p. 25.)

Professor TATE said that it afforded him great pleasure to bear testimony to the excellence of Mr. Tepper's paper dealing with the distribution of the indigenous plants of Yorke's Peninsula in relation to the hydrographical and geological conditions. The Rev. J. E. Tenison Woods, in his "Geological Observations in South Australia," 1862, has pointed out the general dependency of floral features of certain parts of the South-East on geology; but in the present essay we have a first attempt to connect the distribution of particular plants with that of certain rock formations. The author recognises the influence of the rock formation as exerted through its physical properties—not through its chemical ones. Thus, a plant has predilection for granite not so much on account of the chemical constituents, which it may derive from the disintegration of the

rock, but rather from the circumstances of finding there such combination of physical conditions most favourable for its growth and propagation. Hence, a species restricted in the Ardrossan area to a granite may exist elsewhere on a rock of a very different type, provided always it presents the surface and sub-surface features of the granite. As instances of the kind he mentioned that *Casuarinæ* and *Pittosporum phillyræoides* cling to the quartzite bands in the Hundred of Munno Para, though they are generally distributed about Ardrossan; *Nicotiana suaveolens* lives on the Silurian limestones only about Ardrossan; but farther south about Stansbury, it occurs only on the seaward face of the Miocene cliffs. Local peculiarities most certainly occur, but they are not of sufficient magnitude to affect the aspects of the vegetation, which prevail over very large tracts of land in this country. Though they give rise, in some substances, to abnormal features; thus *Salsoli Kali*, which in Europe and throughout littoral Temperate Australia lives only within the influence of the sea, is a characteristic plant in the arid interior of this continent. Its presence there cannot be explained on the supposition that it has survived the geological changes which converted the interior from a submarine area to a continental one. Other plants, such as *Salicornia arbuscula* or samphire, are similarly out of place. The excessive variability of temperature and of the amount of aqueous precipitation, as rain and dew, must in conjunction with the hygrometrical properties of the soil determine to a large extent those lines of demarcation which separate extensive tracts of forest land from grass land regions, and in other cases. In tropical countries this phenomenon is still more marked, and the line of junction of absorbent and retentive soils can be traced on the surface by the changes in the botanical features. Perhaps in no other case is there such an intimate association between plants and soil, as is shown by
he vegetation flourishing on the fluviatile Tertiaries, which
ur here and there from Cape Jervis Promontory to beyond
ootpa. It did not escape the notice of Mr. Selwyn, who
—"On crossing the bridge over the Onkaparinga at
n, and ascending the steep hill on the south bank of
sudden change takes place in the character of the
the presence of Tertiary rocks is at once indicated
sandy soil, and thickly covered with epacris,
warf banksia, coarse grass, and other scrubby
acteristic of sandy Tertiary deposits." The
o much peculiar as it is distinctive as a
patches occur which do not present the
nd it must be evident that other circum-
emblage of the plants on these par-

ticular tracts. The gregarious habit of many of our native plants is a very striking phenomenon, and in some parts of the interior acquires very considerable magnitude.

ORDINARY MEETING, MAY 4, 1880.

Professor RALPH TATE, President, in the Chair.

The list of donations to the Library was read.

The HON. SECRETARY read the petition to Her Majesty the Queen, praying that she would become patron of the Society, and that it might be styled "The Royal Society of South Australia." He also read the report of the Committee appointed to draft regulations *re* organization and direction of efforts of correspondents in natural history.

NOTES AND EXHIBITS.

Mr. MOLINEUX produced some specimens of a large moth (*Cossus cinereus*), together with the larvæ, chrysalis, and silk-lined tunnels, and said it came out at two different periods of the year. In December one moth came out from the trunk of the tree in an upward direction, and left a large hole, into which the water found its way, rotting the tree and ultimately bringing it down. The other moth came from the ground in the roots in April and May. Coming out of the bole of the tree, they made no nest or silk, but, issuing from the root, the moth made a long chamber, of which he showed a sample. The larvæ and chrysalis existed in the tube for some considerable time. He was of opinion that the two must be different kinds of moths.

The PRESIDENT expressed the opinion that the moths were of two different species, and cited Mr. Tepper.

Mr. MOLINEUX said the nest made was of stiff clay. He had found nests, one with a caterpillar and others with a chrysalis inside. The chrysalis was often found near the top of the chamber.

There was a discussion, and Mr. SMEATON said he thought the moth was the same as that described as the *Zeuzera eucalypti*.

Mr. F. G. WATERHOUSE, C.M.Z.S., on behalf of the Governor of the South Australian Institute, exhibited a number of fossil bones recently obtained by Mr. R. M. Robertson at Salt Creek, Yankalilla, comprising portions of skeleton of the *Diprotodon australis*, including part of a lower jaw containing two incisors, portion of lower jaw with three molars, portions of two very large upper incisors, part of a rib, part of pelvis, two caudal vertebra, two portions of tibia, two portions of femur. He also exhibited a specimen of some remarkably rich auriferous

quartz from Woodside, taken from workings recently commenced there.

Master A. C. Molineux exhibited some freshwater shells; Mr. O. Tepper graphic granite and flowering branch of *Melaleuca uncinata*; Mr. Chandler flowering plants from Central Australia, and rock specimens and fossils from about the Peak; and Mrs. Richards flowering plants from the Great Australian Bight. (For particulars of the above see Miscellaneous Contributions.)

The following communication was read:—"Further Notes on Australian Salenariadæ." By the Rev. J. E. T. Woods, F.L.S., Hon. Memb. By consent of the Council this paper is incorporated with the author's first contribution, the publication of which was postponed last year. (See p. 1.)

ORDINARY MEETING, JUNE 1, 1880.

Professor RALPH TATE, F.G.S., President, in the Chair.

The list of donations to the Library was read.

NOTES AND EXHIBITS.

Professor TATE exhibited a skull of a wombat, obtained at the Willows during the construction of the deep drainage works, from the red loamy clays so characteristic of the Adelaide Plain. Skulls of the recent species of the Murray Plain and of the Great Australian Bight were shown for comparison, and though the fossil presents a greater resemblance to the latter, yet it is markedly distinct. In the absence of other materials for comparison, Professor Tate would not assign to it a specific name. In speaking on the subject, he remarked that our Public Library was very deficient in the literature of Australian zoology, and especially of this colony. Professor Owen's classic work on the Extinct Marsupials of Australia was an important desideratum.

Mr. F. G. WATERHOUSE, C.M.Z.S., showed a number of saurians, portion of a large collection of reptilia, lately received by the Governors of the South Australian Institute from the Paris Museum; also the snout of a large sawfish, the skin of a remarkably large brown snake, from Hindmarsh Island, measuring eight feet in length; and some rough Brazilian diamonds.

Professor TATE exhibited specimens of South Australian granites, showing inclusions. He said those from Port Elliot and Victor Harbour contain inclusions of a schistose character, which can only be regarded as fragments of extraneous rocks which have been caught up by the erupted granite and enclosed within its mass. The granite from Palmer and Mannum con-

tains inclusions of a different kind, which seem to be the result of an abnormal arrangement of the minerals constituting the granite itself. In respect to the specimen exhibited which was obtained from the massive granite boss situated on the east bank of the River Murray, about four miles north from Mannum, one may observe a dark circular area of three inches in diameter, which might, on a cursory inspection, be taken for a section of a more or less globose imbedded fragment of another rock, so strongly does the dark interior contrast with the exterior red of the granite. But on closer view the interior is found to be only much finer in the grain than the enclosing granite, whilst the darker colour is accounted for by the larger proportion of black mica. So far as his observations extend, granites having inclusions of the first kind are obviously eruptive, whilst those containing inclusions of the second kind are metamorphic.

The following communication was read:—

I. "On the Bay of Biscay Country," by Mr. J. G. Otto Tepper, F.L.S., Corr. Memb. (See p. 91).

A short discussion ensued, and Mr. Smeaton gave an illustration of Mr. Tepper's theory by diagram drawn on the blackboard.

Professor Tate mentioned that the Rev. J. E. T. Woods formerly held the opinion that the Bay of Biscay country might be attributed to gaseous exhalations.

Mr. Scoular supported that theory.

Mr. Smeaton remarked that at the time Mr. Woods promulgated the gaseous theory he was only acquainted with the South-Eastern country, and believed the Bay of Biscay country only occurred in country subject to inundation. He was not aware that similar curious formations were to be seen in the North.

Mr. Smeaton said he agreed with Mr. Tepper in part of his theory, but not in respect to his view of the original formatio being connected with mud flats.

Ordinary Meeting, July 6, 1880.

Professor Ralph Tate, F.G.S., President, in the

The list of donations to the Library was read

Notes and Exhibits.

Specimens of fresh-water shells from C

Mr. Chandler.

A snake of about nine inches, mar

orange and black, said to have b

Prof. Tate.

A considerable number of specimens of exotic snakes, stuffed and in spirit; also, a sample of rich silver ore; by Mr. Waterhouse, on behalf of the South Australian Institute.

The following papers were read:—

"On some New Corals from the Australian Tertiaries," by the Rev. J. E. Tenison Woods, Hon. Memb. (See page 99).

"On some New Species of South Australian Pulmonifera," by Prof. Ralph Tate. (See p. 102.)

"On a New Belemnite from Central Australia," by Prof. R. Tate. (See p. 104.)

A Translation of Professor Quatrefage's "Craniologie des Races Australiennes," by Professor Tate. The paper in question dealt with the various opinions on the subject of the origin of the Australian race, whether or not the black population of Australia were indigenous or had in far-back times found their way over here from other regions. The craniological characteristics were dealt with, measurements showing the extraordinary length of the Australian native's skull being given. The conclusions arrived at were that there are two indigenous races in Australia; the one spread all over the continent, and presenting a marked homogeneity; the other, termed the Australoid—now confined to the South-East of Australia, and represented by few individuals—presents craniological characters typefied by the fossil Neanderthal skull.

ORDINARY MEETING, AUGUST 3, 1880.

Professor RALPH TATE, F.G.S., President, in the Chair.

The list of donations to the Library was read.

NOTES AND EXHIBITS.

Mr. F. G. WATERHOUSE, C.M.G.S., Curator of the Adelaide Museum, on behalf of the Governors of the South Australian Institute, exhibited an interesting collection of exotic Batrachia, and some specimens of fresh-water tortoises received from the Paris Museum, also a few fossils from the Murray Cliffs near Morgan.

Professor TATE showed a number of mineralogical specimens sent to him by several correspondents, including a piece of translucent opal, distinguished by the name of Hyaline, found by Mr. Scoular in the slates at Munno Para; also some minerals sent by Mr. Salter, of Blinman, comprising Breunnerite, a carbonate of lime and magnesia, found at Nuccaleena; a flesh-coloured heavy spar, and a botryoidal form of magnesite, found at Blinman, and several other minerals sent by other gentlemen.

Mr. H. Lattorff forwarded particulars as to the strata gone

through in sinking a well on the western side of Lake Torrens, at a distance of about ten to eleven miles, and at an elevation of about 800 feet above the sea. The well was sunk to a depth of 128 feet when the borers came upon the bed rock, consisting of hard red slate (gneiss form), containing glimmer.

The following paper was read:—"On the Descriptive and Economic Geology of Munno Para East," by Mr. Gavin Scoular, Corr. Memb. (See p. 106.)

Professor TATE thought Mr. Scoular had proved himself a very careful geologist. He had reviewed the map, &c., and could state that Mr. Scoular had assisted greatly in the work of collecting information upon the geology of South Australia. The quartzites referred to had attracted his own notice when he first arrived, and he did not think such a marked feature as these bands presented on the banks of the Little Para River could be found elsewhere in South Australia. Mr. H. Strother had been over that part of the country, and thought it a remarkable piece of rock scenery—so remarkable that he contemplated taking a picture of some parts for exhibition at the Melbourne Exhibition.

Professor TATE defended his view of the lacustrine origin of the Upland Miocene, and contended that as the neighbouring outlier at Golden Grove was bounded on the west by higher land, so the contemporaneous deposits in Munno Para may have been accumulated in a lake whose western margin was the northerly continuation of that high land, since removed.

A long desultory conversation ensued, and the members separated at a rather late hour.

ORDINARY MEETING, SEPTEMBER 21, 1880.

Professor RALPH TATE, F.G.S., President, in the Chair.

Dr. W. Gaze and Mr. W. Smith were elected Fellows.

The list of donations to the Library was read.

Mr. E. P. Nesbit, jun., was appointed Auditor.

A copy of a despatch from the Secretary of State for the Colonies, notifying that Her Majesty had been pleased to assent to the prayer of the petition requesting her to become the patron of the Society, and to allow it to be known as "The Royal Society of South Australia," was forwarded by His Excellency Sir W. F. D. Jervois, and laid upon the table.

Notice of motion was given as to certain alterations in the Rules rendered necessary by the change of title and by the adoption of a scheme for the systematic record of Natural Science phenomena.

Dr. Wylde sent specimens of a minute moth, the smallest

known to him, which appeared to live on the leaves of *Salvia officinalis*.

The following communication was taken as read:—"On the Tertiary Palliobranchs of Australia," by Prof. Tate. (See p. 140.)

Mr. Charles Todd, C.M.G., here took the chair, and Prof. Tate gave a popular lecture "On Lamp Shells," in the course of which he said that the Australian seas have yielded fifteen species of palliobranchs, some of which extend to New Zealand, there associated with two restricted species. Our waters have furnished only four species, and with the exception of *Waldheimia flavescens* are of extreme rarity. They are:—

Waldheimia flavescens, which occurs around the south-east and south coasts of the continent. He had collected it at the two extremes of our coast-line.

Terebratulina cancellata has been found in dredgings on two separate occasions from Backstairs Passage by Mr. Bednall and Mr. S. Smeaton. Of the few individuals extant in the cabinets of our local conchologists, one only is adult. It is the largest living species in the genus.

Kraussia Lamarckiana is known as a South Australian shell from a few detached valves collected on the east shore of St. Vincent's Gulf.

Discina tenuis, described by Sowerby, is reported in Reeve's "Monograph of Crania" from China and South Australia. *It* is unknown to collectors here.

Annual Meeting, October 5, 1880.

Professor Ralph Tate, F.G.S., President, in the Chair.

The list of donations to the Library was read.

Dr. Nesbit was elected a Fellow.

The Hon. Secretary read the annual report and balance-sheet (see page xxxiv.), which were ordered to be printed.

Several alterations in the rules rendered necessary by the Queen's assent to the assumption by the Society of the title "Royal Society of South Australia," as also by the operations of the newly-organised division for the direction of efforts for the record of natural science phenomena, were agreed to after a short discussion.

Votes of thanks were accorded to the officers for the past year.

The following gentlemen were declared to have been duly elected as the officers and council for the ensuing year:—*President*—His Honor Chief Justice Way; *Vice-Presidents*—Messrs. C. Todd, C.M.G., and F. Chapple, B.A., B.Sc.;

Treasurer—Mr. T. D Smeaton; *Hon. Secretary*—Mr. W. Rutt; *Councillors*—Mr. D. B. Adamson, Dr. Magarey, Pr Tate, and Dr. J. D. Thomas.

The following papers were taken as read:—"Ind: "Diagnoses of New Species of Plants from South A described by Baron F. von Mueller, translated an Plants of the Macdonnell Ranges," by Rev. J. Kem nicated by Mr. Stirling Smeaton, B.A.

The PRESIDENT then read his annual address (se which was ordered to be printed with the Transac

REPORT OF THE COUNCIL

OF THE

Royal Society of South Australia,

FOR THE YEAR ENDING SEPTEMBER 30TH, 1880.

The Council have pleasure in reporting that the work of the Society has been carried on successfully during the past year, the following papers having been laid before it:—"Red Rust," by J. G. Otto Tepper, F.L.S.; "The Medicinal Uses of Wattle Bark," by S. J. Magarey, M.B.; "The Geographical Distribution of Plants in South Australia," by Professor Ralph Tate, F.G.S., &c.; "The Comet of February, 1880," by Charles Todd, C.M.G., F.R.A.S., &c.; "The Characteristics and Distribution of the Native Plants of Yorke's Peninsula," by J. G. Otto Tepper, F.L.S.; "Further Notes upon Australian Selenariadæ," by Rev. J. E. T. Woods, F.L.S., &c.; "Bay of Biscay Country," by J. G. Otto Tepper, F.L.S.; "Translation of Professor Quatrefage's 'Craniologie des Races Australiennes,'" by Professor Ralph Tate, F.G.S., &c.; "Some Fossil Corals," by Rev. J. E. T. Woods, F.L.S., &c.; "A New South Australian Belemnite," and "Some New South Australian Snails," by Professor Ralph Tate, F.G.S., &c.; "The Descriptive and Economic Geology of the Munno Para Hills," by Gavin Scoular; "A Monograph of the Tertiary Palliobranchs of Australia," by Professor Ralph Tate, F.G.S., &c.; "Native Plants of the MacDonnell Ranges," by Rev. J. Kempe; and "Diagnoses of New Species of Plants from South Australia," by Baron F. von Mueller, translated by S. Smeaton, B.A.

A large number of interesting specimens of natural history and other objects of interest have been exhibited and discussed at the Society's meetings. The Governors of the South Australian Institute have laid before the Society from time to time a selection from the donations to the Museum received by them, and private gentlemen have, to a greater extent than in any previous year, contributed in a similar way to the interest of the Society's meetings. In order to encourage and to assist private research, and to place the information thus acquired permanently upon record, the Society resolved early in the session to establish local correspondents throughout the province, and to obtain the services of competent referees in the various branches of natural history. This scheme has been fully matured by the Council, and the assent of the members

will be asked to certain alterations in the rules necessitated by the former resolutions of the Society upon this subject. The plan has already produced good results, and it is hoped that when in full operation it will lead to the accumulation of a large number of facts which would otherwise have remained unknown to the scientific world. The Government subsidy, which has been received for the first time this year, will assist in meeting the increased expenditure incurred by the enlargement of the sphere of action of the Society, whose usefulness will only be limited by the numbers of the subscribers to its funds.

The "Transactions and Proceedings" for 1878-9 were issued early in the session, and the greater portion of the volume for the session now closing is already printed. It is satisfactory to know that the value of the Society's work is increasingly appreciated by the learned Societies of other countries, as is shown by the increase in the number of such Societies which have responded to our invitation to exchange publications.

In accordance with a resolution of the Society, the Council has taken the necessary steps to obtain permission to assume the title of "The Royal Society of South Australia." Her Majesty has graciously acceded to our request, and the Society has thus been placed upon an equal footing with similar Societies in the other colonies.

While the work of the Society has been steadily developing the Council regret to report that the number of members has not increased, being now 102 as against 105 at the last annual meeting. Thirteen names have been added to the roll in all classes. One member, Mr. A. Murray, whose connection with the Society dated from the year 1858, has been removed by death; eight have resigned; and seven have been struck off the roll for non-payment of their subscriptions.

In a comparatively small community, such as that of Adelaide, there must of necessity be a very limited number of individuals sufficiently conversant with any one branch of science to take an intelligent interest in the details which make up the bulk of the papers submitted to the Society, and it is worth while to consider whether it would not be well to supplement the more technical papers with lectures of a more popular character. Such lectures would not be suitable for publication in our proceedings, but would greatly increase the interest taken in our monthly meetings, and might be the means of assisting many in their pursuit of science.

The balance-sheet shows that the finances of the Society are in a flourishing position, the balance in hand last year being £127, and this year about £187; but the cost of printing the Transactions will absorb a larger sum than before.

THE TREASURER IN ACCOUNT WITH THE ROYAL SOCIETY.

Dr.	£	s.	d.
To Balance brought forward	127	15	7
Subscriptions	81	7	0
Government Grant-in-aid	118	16	6
Sale of Transactions and Reprints	2	9	0
	£330	8	1

Cr.	£	s.	d.
By Contribution to Institute	12	0	0
Printing, &c., of Transactions	88	16	9
Advertising and Printing	22	16	10
Salary of Assistant Secretary	12	12	0
Commission collecting Subscriptions	1	15	9
Back to Cupboard	2	13	0
Postages and Sundries	7	8	0
Balance carried forward	187	5	9
	£330	8	1

Audited and found correct,

4th October, 1880.

E. PARISS NESBIT, Auditor.

THOMAS D. SMEATON, Treasurer.

Vienna—Denkschriften der K. Akademie der Weissenschaften. Math. Natur. Classe. Nos. 10 to 19, 1880.
——— Verhandlungen der K. K. Zoologisch-Botanischen Gesellschaft. Vol. XXIX., 1879.
——— Verhandlungen der K. K. Geologischen Reichsanstadt, 1879.

MISCELLANEOUS BOOKS AND PAMPHLETS.
(Names of donors in italics.)

Clark, Rev. W. B.—Remarks on the Sedimentary Formations of New South Wales.
Giles, E.—Geographic Travels in Central Australia. *Presented by Baron F. von Mueller.*
Haast, Dr. Julius von—Geology of the Provinces of Canterbury and Westland, N.Z.
Liversedge, Prof.—On the International Congress of Geologists at Paris, 1878.
Mueller, Baron F. von—Native Plants of Victoria.
——— Fragmenta Phytographiæ Australiæ.
——— Introduction to Botanic Teaching at the Public Schools in Victoria.
——— Organic Constitution of Plants and Vegetable Substances and their Chemical Analysis.
——— Eucalyptographia. Decades 4, 5, and 6.
Russell, H. C.—Rain and River Observations in New South Wales, 1880.
Schomburgk, Dr. R.—Naturalized Weeds in South Australia.
Taplin—Folklore, &c., of the South Australian Aborigines. Adelaide, 1879. *The South Australian Government.*
Todd, C.—Meteorological Observations at the Adelaide Observatory, 1878.
——— Rainfall of South Australia.
Woolls, Rev. W.—Lectures on the Vegetable Kingdom.
——— Plants Indigenous to the Neighbourhood of Sydney, 1880.

THE ANNIVERSARY ADDRESS OF THE PRESIDENT,

PROFESSOR RALPH TATE, Assoc. Lin. Soc., F.G.S.

DURING the past year my leisure has been so severely and continuously taxed for the service of the Society that it has been impossible for me to prepare an address upon an appropriate subject for an occasion like the present. The theme which I had selected early in the year on "The Relationship of the Recent to the Tertiary Fauna of Australia," had to be abandoned, because the collocation of published facts and the determination of the specific and generic affinities of the fossils with recent forms of life, which would be the groundwork of the dissertation, proved to be a task that could not be accomplished within the time, except at the sacrifice of the performance of certain duties in my capacity as President of the Society and co-Editor of its publications.

In its stead I propose to take a retrospective glance at the condition of our Society for the past three years, during which time I have been honoured with the chief direction of its affairs, and also to furnish a record of the current literature dealing with the Natural History of Australia, more especially that relating to this colony.

The application made to the Government last year for pecuniary assistance has graciously been granted, and with th additional means at its command the Society is strenuor endeavouring to attain the main objects which it appears t it ought to have in view.

One of its main objects ought ever to be to foster petuate the taste for natural history throughout th And in this connection the Society, recognising t importance of a corps of volunteers from whc ledge they may expect to derive benefit, scheme for encouraging and directing the naturalists. The scheme has been publi past month, and already a nucleus of wo It has been highly approved by those mitted, and the leading specialist ralists have freely consented to ac tive departments; their names

because it is desirable that the Society be the channel of intercommunication, and filter as it were through the available local talent the possibly new facts from the certainly known. So far the machinery seems to be well devised and adjusted, and the experiment deserves success.

By this scheme the Society encourages the tyro-naturalists in their pursuits, an aid which is not afforded at present by the collection in our provincial Museum. But as soon as they shall have been well named and made easily accessible they should supply the professed student of biology with as complete materials for his researches as can be obtained. In the interest of the Institute Museum I offer the suggestion to the Board of Governors that the Trustees of the British Museum should be reminded not to forget this colony in its distribution of the duplicate specimens, which under a recent Act of Parliament they are empowered to part with. South Australia, in common with the sister colonies, has a claim upon the national Museum, to what extent it is difficult to determine; but that it owes to us some of its knowledge of the natural history of the colonies is obvious from the number of presentations made to it by South Australian collectors and correspondents.

As a further means in the same direction, the entry of all deserving students into our body has been facilitated. The pursuit of collecting and studying natural history objects give to the persons who are inclined to devote their leisure hours to it a beneficial training for whatever their real calling in life may be; they acquire a sense of order and method; they develop their gift of observation; they are stimulated to healthy exercise.

The meetings of the Society have been held with regularity, but in consequence of the great subdivision of science and the more technical character of the communications they have not been attended so well as in former years, when it was thought fashionable to do so. To revive such a former state would indeed be a retrograde action, as it would impair the efficiency of the Society. It must, moreover, not be expected that it lies within the province of the Society directly to impart elementary knowledge. Our meetings are held for the purpose of having new facts, or new views of the bearing of admitted facts, or corrections of important errors, brought before us for discussion, and not for mere elementary instruction, though some of us could probably testify as to how much may be incidentally learned through a constant attendance at the meetings. A middle course is, however, open by which we may hope to acquire popularity without in any particular impeding the attainment of the higher objects of the Society—that is, by the delivery of popular expositions of recent advances or of

echinodermata of South Australia, of a catalogue of the polyzoa inhabiting our waters, and of a paper on the geological structure of the Adelaide mountain chain.

I notice with pleasure that science forms part of the curriculum for teachers in training, and that encouragement in the study of botany has been given to pupils in our State schools. Cheap and good elementary text-books on botany are procurable, but before a more general study of our native plants can be initiated a manual is required somewhat after the model of Baron F. von Mueller's "Native Plants of Victoria." At present the only descriptive work is the "Flora Australiensis," of seven volumes, far too costly to be accessible to the many. A manual of South Australian botany, if restricted to the flowering plants and ferns of the settled districts, could be published at a price to bring it within the reach of all. We commend the suggestion to the Minister of Education.

Another great advantage our Society affords is the possession of a library of volumes, acquired by presentation or by means of exchange of our publications, which are of the greatest value to the student and are not extant in other libraries in this city. The number, it is true, is at present small, but the yearly additions are largely on the increase.

The increase in the number of members during the last three years has been much in excess of that for any former corresponding period, but losses have been disproportionately great.

Having thus pointed out what we have at our command to forward the interests of science in this colony, and what is being done in its behalf, and incidentally indicated some of the advantages that may be gained by joining our body, I will now address myself to those who are still doubtful as to the advantage of doing so.

The sphere of the Society's usefulness, other things being the same, is the more extended as its revenue is increased. Thus we want funds to stimulate and reward those engaged in investigating the natural history of this colony, and in other directions not strictly of a commercial character. It is the duty of all who wish to advance the study of nature to do what in them lies, and relieve such enthusiastic workers, that we have reason to know are amongst us, from the pecuniary burthen which their self-denying labour brings upon them.

The names of some Fellows of learned Societies, and many of the learned professions, are absent from our list of Fellows; why do they not further the progress of research, and make it possible for the Society to produce such works as would be of inestimable value, and redound to the credit of the whole community, whose intellectual status has been pronounced by

certain recent visitors, competent to judge, to be of a very low degree? It is obvious that a combination of members can produce a greater amount of valuable results than they would in the aggregate if working independently. And this Society, in its corporate capacity, performs services which no individual or individuals unassociated could render. It is a connecting link between the scientific workers of this and the neighbouring colonies.

The contention is, that because an individual cannot take an active part in the Society it is no commendable reason for his refusal to aid it. There are several gentlemen having natural history predilections who have and may profit by the results already achieved by the Society, yet are devoid of a patriotism for science; and there are others foremost among us as physicists, who if they were zealous in the cause of science would embrace the opportunity afforded by the meetings of the Society to communicate to an anxious and intelligent section of the community the results of investigation which they have been enabled to prosecute at the country's expense.

In some respects the members of this Society have themselves to blame, and I must acknowledge that I have been at times much disheartened at the apparent apathy for that which concerns the very existence of the Society. If the fault has been mine, then I shall be only too glad, for the Society's welfare, that it be proved from this evening forthwith to have been so.

In the President-elect you have a gentleman who brings a prestige to the Society, and whose well-known earnestness in the discharge of all public duties is a guarantee that in him you will have a warm advocate and a zealous partisan. He has told you that he is not a scientist, but in doing so he gives to the word a very restricted definition. We have had, perhaps, too much of what he regards as science—not too much absolutely, but rather too little of what is not natural science—and we anticipate that under the fostering care of our new President greater attention will be given to those departments of science which have been neglected by us for some years past.

In adopting the title of Royal Society of South Australia you have imposed on yourselves greater obligations. And as the change of title cannot materially affect the constitution of the Society, it behoves its members to greater exertions to justify their high pretensions. Let each member strive to deserve the honour of being its President.

It affords one pleasure to note the increasing activity of the several scientific bodies throughout the Australian Colonies, as is partly indicated in the summary of recent progress in natural history with which I shall conclude this address. New life has been infused into the almost defunct Microscopical

Society of Victoria by the untiring energy of its Secretary, Mr. Goldstein. It has already issued two quarterly parts of its Journal of seventy-eight pages and five lithographic plates. One valuable feature of the new Society is the holding of practice-meetings once a week. "These have become very enjoyable, partaking more of the character of Club meetings, where the members, unfettered by formalities, converse freely on subjects of interest, and where they may seek and obtain such help as they require." The naturalists of Melbourne have banded together under the title of a Field Naturalists' Club, for the purpose of outdoor work, and the meetings have been well attended. The zeal of its leaders cannot fail to stimulate an enthusiasm in others, and the Club will doubtlessly prove an efficient training-school for young naturalists. I have long since wished to have engrafted on our Society something of the character of a Field Club, but I have always been dubious as to whether such a character could be sustained.

RECORD OF CURRENT LITERATURE RELATING TO THE NATURAL HISTORY OF AUSTRALIA, PARTICULARY OF SOUTH AUSTRALIA.

Mr. R. Alston describes the anatomy of the little-known marsupial, *Antechinomys*, which, with *Phascologale*, *Antechinus*, and *Podabrus*, he regards as constituting a sub-family of the Dasyuriadæ. (Proc. Zool. Soc., London, June 15, 1880.)

Mr. E. Dobson, in the same issue, describes a new species of bat from Australia, which, on account of its large size, he calls *Megadorma gigas*.

The collections which have been made during the last few years in the southern part of New Guinea indicate resemblances previously unsuspected between the faunas of New Guinea and Australia. Many genera of mammals which were thought to be peculiar to the continent have been found on the great Papuan island. Among the more remarkable may be cited two species of Echidna (ant-eating porcupines); true, dwarf, and flying Phalangers; Cuscus; Macropus (kangaroos); Perameles or bandicoots; and *Phascologale*. But hitherto the true Dasyures or native cats had not been known to occur in New Guinea. This gap has now been filled up by the discoverd at the Arfak Mountains of a species of *Dasyurus*. This new species has been designated by Prof. A. Milne Edwards (Comptes Rendus, June 28, 1880, p. 1,518) *D. fuscus*, because of the very dark brown colour of its fur. It is the smallest species of the genus, and its size does not exceed that of a large common rat. It is interesting to note that the Australian species which it more nearly approaches, *D. hallucatus*, in

which the hind feet are also furnished with five toes, is only met with towards the northern extremity of Australia.

Professor Owen has determined that the ova of *Echidna hystrix*, in most respects, correspond closely with those of the *Ornithorhynchus*. The fission of the germ mass, like that in the rabbit's ovum, strengthens the conclusion that the Monotremes are viviparous. The functional quantity of both uteri in the genus Echidna corresponds with the equal development of the right with the left female organs, in which it differs anatomically from the *Ornithorhynchus*. (Proc. Royal Soc., London.)

Mr. W. Macleay's recent communications "On the Clupeidæ and Mugilidæ of Australia" (Pro. Lin. Soc., N.S.W., vol. iv., pp. 368-384 and 420 to 427) must further add to his high reputation as an ichthyologist. Since the death of Count de Castelnau he stands alone in this department of zoology.

Of the Herring tribe nineteen species, and of the Mullet tribe fifteen species are enumerated. Here, as in other instances, the name South Australia rarely appears. The author says—"The fishes of the west coast are very little known, and many discoveries are likely yet to be made on the northern; but probably we may accept the above lists as enumerating with some correctness the species of the southern and eastern coasts."

These papers, dealing with two groups affording many edible fish, are replete with information touching their habits, haunts, uses, &c. They raise so many questions of an economic character, that the greatest publicity should be accorded them. The development of our fisheries is of such importance from a national point that it should form a subject for the serious attention of our Government. Mr. Macleay points out the lines upon which an inquiry should be conducted which would accumulate the most useful information.

"Les Staphylinides de l'Australie et de la Polynesie." Par Albert Fauvel, Geneva, 1877-8, 2 vols., pp. 364.

The author has for many years given great attention to this family, and has published, in addition to other voluminous works on entomology, "Monographs of the Staphylinidæ of Central America, of Chili, Reunion, New Caledonia, N. Africa, N. America, and New Guinea." With such preparation, this last production of his pen cannot fail to have that value which results from the matured study of a particular group of living beings.

Mr. Masters' "Catalogue of the described Coleoptera of Australia" (1871-4) enumerates 78 species of Staphylinidæ, but M. Fauvel's census contains the names of 310 as belonging to this continent and Tasmania.

The Australian region comprehends for him three principal sub-regions—

1. The Austro-Malaysian, comprising the group of the Moluccas and that of New Guinea.
2. The Australian, properly so-called, comprising Australia and Tasmania.
3. The Polynesian, extending to the east as far as the Gambier Isles and the Marquesas, to the west to the Solomon Isles and to the Mariannes, to the exclusion of the Sandwich Isles. New Zealand should form an independent group.

The Polynesian fauna numbers 60 species, and that of Australia 310, whilst there are nine species only common to the two sub-regions.

The number of genera in Australia is 76, of which 10 are peculiar. The geographical distribution of the species is as follows:—S.W. Australia, 47; N. Australia, 17; Queensland, 112; S.E. Australia (New South Wales), 82; S. Australia (Victoria, Tasmania, and S. Australia), 122. Five species from Port Augusta are included in S.W. Australia; and the necessary correction will reduce the number of Western Australian species to 42, and raise that of Southern Australia to 127. The number of species determined from South Australian specimens is 24, belonging to 14 genera. Mr. Tepper, in his census published by the Society last year, gives 26 species of 5 or 6 genera.

One of the new genera instituted by M. Fauvel, uniquely represented by a South Australian species, is named *Correa*—a denomination already occupied for a well-established group of Rutaceous plants, a familiar example of which is *Correa speciosa*. As under these circumstances a dual employment of the cognomen will prove of inconvenience, I have been bold to suggest that of *Fauvelia* for the genus of beetles.

The plan of the work is excellent. Under each natural group is a synoptical table of the characters of the genera, and under each genus that of the species. Each genus and species is fully described; the diagnoses are in Latin, but the remainder of the text is in French. The work is not illustrated.

A list of the described Staphylinidæ of South Australia:—

Oxytelus subæneus, *Fauvel*, Port Augusta.
" semirufus, *Fvl.*, "
" impennis, *Fvl.*, Adelaide.
" sparsus, *Fvl.*, "
Xantholinus chloropterus, *Er.*, Adelaide, Port Augusta.
" socius, *Fvl.*, "

Homalota coriaria, *Kraatz*, Port Augusta.
" sordida, *Marsh*, Adelaide.
" politula, *Fvl.*, "
Calodera cribrella, *Fvl.*, "
" australis, *Fvl.*, Port Augusta.
Phlœocharis antipodum, *Fvl.*, "
Trogophlœus simplex, *Mots.*, "
Philonthus sordidus, *Grav.*, "
" hepaticus, *Er.*, "
" nigritulus, *Grav.*, "
Quedius thoracicus, *Fvl.*, "
Heterothops luctuosa, *Fvl.*, "
" picipennis, *Fvl.*, "
Conurus triangulum, *Fvl.*, "
Brachida suturalis, *Fvl.* sp., "
Fauvelia oxytelina, *Fvl.*, "
Bolitochara discicollis, *Fvl.*, "
Pæderus cruenticollis, *Germ.*, "

"**Descriptions of New Species** of Phytophagous Coleoptera." By **Martin Jacoby.** Proc. Zool. Soc., London, 1879, pp. 773 *et seq.* Among others, of one species from Tasmania and of two from Queensland.

Sir John Lubbock describes (in Journ. Linn. Soc., London, Vol. xv., p. 186, 1880) a species of ant having a similar habit to the honey-ant of Mexico, "particular individuals of which are specially told off to serve as receptacles of food or animated honey-pots." This second species of the kind, to which the name of *Camponotus inflatus* is given, is reported to come from Adelaide; but that is, of course, inaccurate. It is probably the species which has, however, been received here from the tropical parts of Central Australia.

"On Seventeen New and Rare Spiders from New Zealand, with characters of four new genera." By Rev. O. P. Cambridge. Proc. Zool. Soc., 1879, pp. 681 *et seq.* Plates 52 and 53. Though not any of the species here described are known to occur in Australia, yet the paper is valuable to us as affording new particulars touching the systematic position of certain of our species and of their alliances.

The Australian Crustacea are being dealt with in a most vigorous manner by Mr. W. A. Haswell, whose previous contributions to Carcinology had indicated the considerable neglect that this class of animals had suffered at the hands of naturalists.

The last two numbers of Vol. IV. of the Proc. Lin. Soc., N. S. Wales, contain the following papers from his pen:—

"The Australian Amphipoda," pp. 245-279, 319-349, plates 7-12 and 18-24 (1879).

The number of described species hitherto known was thirteen only, whilst the above papers contain 75 new species, comprising nine new generic forms. The specimens at Mr. Haswell's command have all been obtained (with two exceptions) from Tasmania and New South Wales, and not one is common to the two areas. The habitat of a species named *Talitrus sylvaticus* is peculiar, being abundant in moist ground in woods and scrubs of New South Wales, extending inland at least as far as about 30 miles from the coast. It has never been observed on the sea shore.

"On some new Amphipods from Australia and Tasmania," *loc. cit.*, Vol. V., pp. 97-105, plates 5-7 (1880). Is a supplemental paper describing eleven new species, one of which is the type of a new genus.

"On the Australian Brachyura Oxyrhyncha" (*loc. cit.*, pp. 431-468, plates 25-27, 1880).

Mr. Haswell's researches among the Australian spider crabs have added 37 species to the nineteen previously recorded; whilst the genera represented has been increased from thirteen to 27 (one new). The greater number of the species was obtained on the eastern coast and in Torres Straits. The new species, seventeen in number, are described, and most of them figured. Whilst full references to the species of earlier authors and authenticated localities are given. South Australia is uniquely represented by *Micippe parvirostris*, originally described by Miers from a Port Lincoln specimen. And in this connection I will quote from the author:—"So little is known of the marine zoology of the south of Tasmania and the west coast of Australia that it is impossible to treat with any degree of minuteness of the geographical distribution of genera within the Australian province. Two well-defined faunas are, however, readily separated and contrasted, viz., the temperate and the tropical."

"On Two New Species of Paratymolus (Brachyura) from Australia" (Ann. and Mag. Nat. Hist., vol. v., pp. 302-4).

A revised list of all the Echini known to the Rev. J. E. Tenison Woods as occurring on the Australian coast will be found in vol. iv. Proc. Linn. Soc. N.S.W., pp. 288-290. This is an amended list to that given by him in vol. ii. of the Proceedings of the same Society. Two new species collected between Moreton Bay and Port Jackson are also described and figured. One, *Hemiaster apicatus*, is interesting as representing a genus previously unknown in a recent state in the Australian seas, and one which is most abundantly represented in cretaceous

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strata; a species is fossilised in the Murray Cliffs. The other, *Phyllacanthus parvaspina*, suggests a generic relationship with *Cidaris Australiæ*, one of our common Miocene fossils.

"Descriptions of New Species of Axinæa and Pectunculus," by G. F. Angas (Proc. Zool. Soc. London, 1 pl., May, 1879).

Includes *A. modesta*, from Australia; *A. Nova-Caledoniensis*, from New Caledonia; *P. Nova-Guinensis*, from New Guinea; and *P. orbicularis*, from Bass Straits. The last is identical with *P. flabellatus* (Tenison Woods, 1877), and is probably a small form of *P. laticostatus*, Q. and G. *P. flabellatus* is living in St. Vincent's Gulf, and is not uncommon in the higher beds of the Miocene formation in various parts of the colony.

The same author in the vol. for 1880 describes and figures (pl. xl.) the following new species of Mollusca from South Australia:—*Helix Bordaensis*, from Cape Borda, Kangaroo Island, which belongs to the same curious group of the section Rhagada as *H. Silveri*, Ang., and *H. Kooringensis*, Ang., from the Northern Areas of this colony. *Glyphostoma pascimaculata*, *Clathurella crastella*, *Rissoina lyrata*, *R. elegantula*, *Amauropsis globulus*, *Adeorbis Vincentiana*, and *Collonia roseo-punctata*, from St. Vincent's Gulf; communicated to the describer by myself and Mr. Bednall.

On the same plate are figured for the first time the magnificent shells *Murex Bednalli*, Brazier, and *Voluta Bednalli*, Brazier, and also *Clanculus bicarinata*, collected by Mr. Bednall at Port Darwin.

"The Cæcidæ of the Challenger Expedition," by Marquis de Folin (Proc. Zool. Soc., London, 1879).

Seven species of this family of gasteropods were dredged by the Challenger off Cape York. They belong to *Parastrophia*, 1 sp.; *Watsonia*, new genus, 1 sp.; and *Cæcum*, 5 sp. With the exception of *C. Chinense*, they are new to science.

"Mollusca of the Challenger Expedition," by the Rev. R. Boog Watson (Journ. Lin. Soc., London, vol. xiv., pp. 692 *et seq.*, 1879; and vol. xv., pp. 87-126, 1880). The only Australian species are *Gibbula glyptus*, n. sp., taken in 410 fathoms; *Solariella Phillippensis*, n. sp., in 38 fms.; *S. albugo*, n. sp., in 2-10 fms., off Port Jackson; *Fossarus cereus*, n. sp., in 1,400 fms., East of Cape York; *Bittium pupiforme*, n. sp., Wednesday Island, Cape York; and *B. cylindricum*, n. sp., 2-10 fms., Port Jackson.

"On the Occurrence of Recent Heteropora." By A. W. Waters. Jour. Roy. Microscopical Soc., London, vol. ii., p. 390, pl. xv. 1879.

In this communication the author has described a species of

Heteropora from the Semaphore, South Australia, under the appellation of *H. cervicornis*, considering it to be identical with the *Plethopora cervicornis*, D'Orbigny, from the cretaceous rocks of France; he also mentions a second species from the seas of Japan. Till the appearance of this interesting communication no recent species belonging to the genus seems to have been published. A third species has been described by Mr. Busk (Journ. Linnean Soc., London, vol. xiv., p. 724, 1879; pl. xv.), which he had received from New Zealand. The occurrence, therefore, of the above three species belonging to a genus of which we had previously no species more recent than the English Crag, and extending back to the Jurassic period, is of particular interest.

Heteropora cervicornis is associated on our coast with a very common Cellepora which has a similar mode of growth; so much that a microscopical investigation is necessary for their separation. Mr. Waters cannot identify the Cellepora with any described species, and distinguished it as *C. repleta*, a figure of which is given; but it is the *C. tubigera*, Hutton (Proc. Roy. Soc., Tasmania, p. 24; 1878.)

Rev. T. Hincks' "Contributions towards a General History of the Marine Polyzoa" (Annals and Mag. Nat. Hist.; July, 1880), give figures and diagnoses of seven species of Membranipora from the Australian Sea; five are new to science, and one—*M. delicatula*, Busk (*Biflustra* sp.)—is common to Australia and Florida, and is fossil in the English Crag. No localities are given for the Australian species.

"The Journal of the Microscopical Soc. of Victoria," vol. i., Nos. 1-8, contains several papers on Polyzoa.

Mr. J. R. Y. Goldstein furnishes diagnoses of two new species—*Serialaria Woodsii* and *Catenicella ponderosa*—obtained at Portland. The same author's notes on living polyzoa supply much new information respecting the polypes of several species.

Mr. Chas. M. Maplestone describes as new *Bicellaria annulata* and *Catenicella pulchella*. The great peculiarity of the first species is the spindle-shaped structure upon which the cells grow; and from the ringed appearance of the individuals the specific designation is derived. In fact, the author thinks that a new genus is requisite for its reception.

Mr. J. Brambridge Wilson has instituted the genus *Catenicellopsis*, separated from *Catenicella* by the mode of branching. It comprises two species, here described as new under the names *C. pusilla* and *C. delicatula*. The same author announces the occurrence of fossil Catenicellæ in the Miocene Rocks at Bird Rock, near Geelong. At least twenty distinct species have already been observed. Their illustration and complete

description are reserved for a future time, though in the present issue the differential characters of twelve species are given, unaccompanied by specific terms.

Rev. J. E. Tenison Woods describes a new genus and species of Polyzoan, under the name of *Tetraplaria australis*, obtained from Miocene strata at Muddy Creek, near Hamilton, Victoria. *Tetraplaria* is allied to *Gemellaria*, but the pairs of cells face alternate in two ways—that is, the faces are on all four sides of the cylindrical branches, and they alternate in each of the opposing cells arising on the side of the centre of its alternate neighbour. (Proc. Roy. Soc., New South Wales, vol. xii.; 1879.)

Rev. J. E. Tenison Woods describes and figures a fossil coral of great beauty from the Muddy Creek Miocene beds. It belongs to the genus *Montlivaltia*, and adds another link to that chain of facts which gives the Tertiary fauna of Australia such a Mesozoic aspect. The species is named *M. discus*. He also establishes a new genus with the name of *Trematotrochus*, and includes under it his *Conocyathus fenestratus*, from the Muddy Creek beds, and *Trochocyathus heterocostatus* from the Aldinga beds. The typical species of this genus combines some of the leading characteristics of several sub-families; it has neither pali nor columella, and the wall is perforated. In exterior form it is very like Antillia. Proc. Royal Soc., New South Wales, vol. xii., 1879.

"On the Cyclostomatous Polyzoa of Port Jackson." By W. A. Haswell. (Proc. Lin. Soc., N.S.W., vol. iv., p. 350, 1879.)

This is a descriptive catalogue of the species of the sub-order occurring in and around Port Jackson. The total of fourteen is made up as follows:—*Idmonea*, 3 sp. (one new); *Pustulipora*, 3 sp.; *Tubulipora*, 1 sp.; *Discoporella*, 5 sp. (three new); *Crisia*, 2 new sp.

"On some Polyzoa from the Queensland Coast." By W. A. Haswell; *loc. cit.*, vol. v., p. 33.

This is a list of 59 species obtained by the author at Port Denison, nearly all of which were obtained with the dredge in a single spot close to Holborn Island, 20 miles to the north-east of Port Denison. "Here the bottom, at a depth of about 20 fathoms, seemed covered with little else than *Polyzoa*. . . These are no doubt in the act of forming by their gradual growth and decay more or less extensive deposits analagous to the Polyzoa beds characteristic of the Tertiary formations of South Australia and Europe." The following are described and figured as new species:—*Crisia*, 1 sp.; *Pustulipora*, 1 sp.; *Onchopora*, 3 sp.; *Scrupocellaria*, 2 sp.; *Membranipora*, 1 sp.;

Biflustra, 2 sp.; *Lepralia*, 6 sp.; *Cellepora*, 2 sp.; *Eschara*, 2 sp.; *Hemeschara*, 1 sp.; *Vincularia*, 1 sp.; *Conescharellina*, 2 sp.; *Selenaria*, 1 sp.; *Sphæropora*, 1 sp.; and *Myriozoum*, 1 sp.

An interesting addition to Australian fossil botany is the extinct conifer *Araucaria Johnstoni*, recently made known to science by the technical description by Baron F. von Mueller, K.C.M.G., appended to the reports of the Victorian Mining Surveyors for the quarter ending September 30, 1879. The species is founded on impressions of branchlets and the summit of a fruit cone, which were discovered very recently imbedded in the yellow Tertiary freshwater limestone near Hobart Town, Tasmania, by the assiduous and circumspect naturalist Mr. R. M. Johnston, F.L.S., of Launceston. The locality where this fossil Araucaria was found is to us of classical interest. It was visited by Charles Darwin, then naturalist to H.M. ship Beagle, during the stay of his ship at Hobart Town, and is alluded to by that illustrious scientist in his "Journal of a Naturalist," p. 448, and also in his work on volcanic islands. It was later examined by Count de Strzelecki, and several of its fossils, leaves, and land shells are figured in that traveller's work, "Physical Description of New South Wales and Van Diemen's Land, 1845." Mr. Johnston considers these organic relics, notwithstanding the close affinity of some of them to forms of the present vegetation, as belonging to the Miocene period, a view also taken by Professor McCoy, and to some extent supported by the father of Australian geology, the late Rev. W. B. Clarke. The phytiferous limestones of Hobart Town are in places covered with a mass of felspathic basalt, and must therefore be of earlier date than the volcanic effusion which Professor Ulrich considers as co-eval with that of Victoria, designated as the older volcanic formation. In various parts of Victoria this basaltic cover conceals the so-called older gold drifts, which contain a now extinct sylvan vegetation made known to us by Baron F. von Mueller's numerous "Observations on New Vegetable Fossils of the Auriferous Drifts." Mr. Johnston has found in association with the new conifer congeneric and even conspecific types of plants from the Victorian gold drifts, thus leaving little room for doubt as to the contemporaneity of the two widely separated plant-bearing deposits. One point of interest attached to the discovery of *Araucaria Johnstoni* is that of the geological distribution of the genus. The earliest traces of distinctly coniferous wood known, those from the carboniferous system, belong to the Araucarian type; but the actual genus *Araucaria* does not go farther back than the Trias. It flourished in Jurassic times in Europe and India, but is not definitely known at present in Cretaceous rocks, and it has generally been held that Araucarias

became extinct north of the equator since the Oo
In a living state they are confined to extra-tropical
tropical South America, Australia, New Zealand, ar
the South Pacific Islands. Of these two familie
known as the "Norfolk Island Pine" and the "
Pine." The Oolite of Europe in the relics
animals, in the remains of fish analogous to th
shark (*Cestracion*), and in the still more remark
of the molluscan genus *Trigonia* and of
Araucarias still existing in Australia, afford s
pondence with the present fauna and flora o
the globe. From these circumstances it h
held that Australia, in which alone this
zoology and botany has been preserved,
connected with India and Europe by dry

The researches of Mr. J. Starkie G
plant-bearing strata of Bournemouth, F
established the fact that a species of A
able by any discoverable character fro
forms vast forests on the shores of
abundantly in England during the
Here its associates were, amongst ot
and many Proteaceæ, which are str
hemisphere. The presence durin
is now cold temperate Europe
the warm temperate and sub-tro
hemisphere, proves that some
Australian genera neither origi
in Australia, and whose ve
accomplished in part before th
of Araucarias in a fossilise
and belonging to an early
of great interest, as estab
series of changes which se
epoch.

"Fragmenta Phytogr
Fasiculus xci., Feb.
posites *Leptorrhynchus*
A. Cunningham. Th
of the former by B
leading differential

L. elongatus, cor
gated, glandular-

L. medius, co
smooth, with a

e

Fasiculus xcii., August, 1880, contains descriptions of the following new species discovered in South Australia:—

An Acanthaceous plant, *Justicia Kempeana*, p. 101, from near MacDonnell Ranges. (Rev. H. Kempe).

A cyperid, *Schœnus Tepperi*, p. 106, near Ardrossan. (O. Tepper).

A fungus. *Battaria Muelleri*, Kalchr. *M.S.*, p. 106, near Ardrossan. (O. Tepper).

ON SOME RECENT AND FOSSIL SPECIES OF AUSTRALIAN SELENARIADÆ (POLYZOA).

By the Rev. J. E. Tenison Woods, F.G.S., F.L.S.,
President of the Linnean Soc. of N.S.W., Hon. Member of the Adelaide Phil. Soc., &c., &c.

(Read September 2, 1879.)

[Plates I—II.]

The Selenariadæ is a family of Polyzoa, proposed by Mr. G. Busk in 1853 in the British Museum Catalogue of that class (part 2, p. 97). It is comprised in the order Gymnolæmata, sub-section Inarticulatæ, suborder Cheilostomata, section Rigidæ, group Liberæ, or with the zoarium unattached, usually discoid, conical, or irregular. The family includes orbicular, or irregular conical or depressed zoaria, which are convex on the upper side, and plane or concave on the other. They are composed of a single layer of cells, usually of two kinds, which open on the convex surface only. They were included among Foraminifera by Lamarck and Lamouroux; but the latt classed them amongst his Milleporidæ, and suggested subgenera *Cupularia* and *Lunulites* (Exposit. Method., p which Busk subsequently adopted as genera. The true placed them at the head of his family Cellariæa, ar of the organisms was perceived first by De Blainv *Flustra*. He characterises his genus *Lunulites* as c cellules, with a superior opening disposed in cor and radiating lines, so as to form a calcar somewhat regular orbicular, convex above, c marked with furrows radiating from the c ference. He cites as species *L. radiate* vert., vol. 2, p. 191), copied into the E fig. 6 a. b. (Atlas, pl. 75, fig. 5 a. b.) and Lamouroux (Gen. Polyp., pl. adds that this genus has been est above two small fossils, only d being free and having a deterr remarks, further, that the

Lamouroux's esti mation to possess features entitling it to generic distinction, for which he proposed the name of *Cupularia;* and he says that in effect the disposition of the cells is somewhat different, and the polypidom is not radiate.

Lunulites are described by Munster (Goldfuss, Petrefac, Germ., 1826, vol. i., p. 105; plate 37, fig. 7, *L. rhomboidalis*), by Michelin (Iconograp. Zool., 1841, p. 279, plate 63, fig. 12, *L. Vaudenbeckii*), and by A. E. Reuss (Naturwissen schaftliche, Abhandlungen, Vienna, vol. ii., p. 58, plate 7, fig. 26 and 27). The genus is also mentioned by Hagenow (Bryoz., Maestr. Kreid., plate 12, fig. 15 and 16), D'Archiac (Mem. Soc., Geol. de France, vol. ii., p. 196, plate 5, and vol. iii., p. 412), Leymerie (op. cit., vol. i., p. 358, plate 13), P. H. Nyst (Descrip. des Coquilles et Polypiers Fossiles de Belgique, p. 624, plate 48, fig. 6-8), Defrance (Diction. des Sciences Naturelles, vol. 27, p. 360, Atlas plate 50, fig. 5), Deslongchamps (Encycl. Zooph., p. 501), Mor ren (Decrip. Coral Foss. in Belg. report, 1828, p. 44), Lea (Contrib. to Geol., plate 6, fig. 202), Galeotti (1837, Mem. Geog. du Brabant, p. 163), Scacchi (1834, Notizie inta alle Couch ed a Zoofite Foss., p. 16, plate 2, fig. 7, 8), Lonsdale (Jour. Geol. Soc., vol. i., p. 503), S. Wood (Ann. Nat. Hist., vol. xiii., p. 18), Conrad (Silliman's Jour., Oct., 1841, vol. xli.), Gray (Spicilegium Zool., part 1, plate 8, b. 3, fig. 15), Busk (Quart. Jour. Micros. Soc., vol. vii., p. 6);* also British Museum Catalogue of Polyzoa; Palæontographical Soc., 1857, Foss. Polyz. of the Crag, p. 78.

It is in the latter publication that Mr. Busk gives a lengthened notice of the whole family of Selenariadæ, and reviews the relations of the existing species to those known as fossil. He figures and describes two species of *Cupularia*, which are found as fossils in the Crag (Pliocene) of Suffolk, England; but one only found alive at Madiera,† the Canary Isles, and the coast of Africa. Also, two species of *Lunulites* which have no living representatives.

In spite of the divisions proposed by Mr. Busk, which are clear and convenient if not quite natural, there is some confusion still as to the limits of the family and the names of some of the genera. *Cupularia* is used by D'Orbigny as a genus of the family of FLUSTRINOIDEA, tribe FLUSTRELLARIA, which includes ESCHARIDÆ, which are entirely without pores, avicularian or vibracular pores, I suppose. This tribe includes *Trochopora*, *Discoflustrellaria*, *Cupularia*, and *Lateroflustrellaria*, all of which have the zoœcia growing on a convex discoidal free zoarium. In *Trochopora* there are radiating lines like costæ

* I have not included Cuvier, Brongniart, or Brown, as their species are doubtful.

† See Jour. Micros. Soc., Oct., 1878.

on the under surface corresponding with the lines of cells. These lines are porous. In *Discoflustrellaria* there are no pores. In *Cupularia* there are neither pores nor lines. They are secondary fossils described by D'Orbigny in his Paleontologie Francaise, vol. 5, p. 506, 513, pl. 601 and 722; Defrance, Dict. Sciences Nat.; Michelin, Icon. Zooph., pl. 77, figs. 9 and 10. It is necessary to bear these distinctions in mind, as it will be seen they apply to some of our Australian fossil species. It seems that while Busk has employed the genus of Lamouroux in one way, D'Orbigny has done so in another, the latter having priority.

There is also some difference of definition for the genus *Lunulites*, for while Busk states that it is never attached at any stage of its growth the *Lunulites* of D'Orbigny, D'Archiac, Leymerie, and Michelin are attached during their young stage; and Hagenow (Die Bryoz., d. Maestricht. Kreidebild., p. 100, pl. 12, fig. 15, 16) states that he has seen *Lunulites semilunaris* and *L. Goldfussi* attached by the entire surface upon Belemnites. Busk thinks the attachment must have been accidental, but my own opinion is that too much importance is given to the character, as free polyzoa are sometimes found encrusting corals, &c.

Mr. Busk points out that in all the members of this family there are, in addition to the ordinary cells, others which differ in size, and whose office was variously interpreted until the discovery by Mr. McGillivray of living examples enabled Busk to determine that they were vibracular cells. The purpose served by the *vibraculum* is not well understood. The organ consists of a cup containing a muscular apparatus, and of a moveable seta articulated to the cup. The *seta* is in most cases simple and fine-pointed, but in some of the Selenariadæ it is bifid or trifid at the extremity. In *Selenaria maculata* it is spirally contorted and minutely annulated, so very closely as to resemble the proboscis of a butterfly. It may serve the purposes of defence and even locomotion, but observations on the subject are needed.

Whatever purpose they may serve, they have been made in the hands of the naturalist useful organs for classification, as will appear from the following division proposed by Mr. Busk in the British Museum Catalogue:—

FAMILY SELENARIADÆ.*

Zoarium free orbicular or irregular conical or depressed, convex above flat or concave below, upper surface only celluliferous. Zoœcia of two kinds disposed in series or quincuncially.

*The orthography in the Crag Polyzoa is *Selenariida*.

The genera of the family are five in number, which are thus distinguished—

CUPULARIA, Lamouroux.—Each cell with a vibracular chamber at its apex or distal extremity.

LUNULITES.—The cells and vibracular chambers disposed in separate, usually alternate, rows radiating from the centre.

SELENARIA, Busk.—Some of the cells only of a different form from the rest and furnished with a vibraculum.

STICHOPORA, Hagenow.—No apparent vibracular cells.

CONESCHARELLINA, D'Orbigny.—No vibracula; mouth of cell circular. Avicularia present.

Hitherto only from Australia species have been described—one *Cupularia* and three *Lunulites*. The latter, according to Busk, are representatives of fossils found in the Cretaceous period—another interesting link between Australia and Mesozoic forms. There are five species recorded from the Pliocene formation, eight from the Miocene, seven from the Eocene, and eighteen from the Cretaceous. Of the latter species only *one* is a *Cupularia* and two *Stichopora*, and the rest, fifteen in number, are *Lunulites*.

Cupularia is now our largest genus, but the existing species of *Lunulites* are very much larger in size than the fossil forms, if we except the giant species, *L. magna*.

I have now to introduce to science twelve new species and a variety in this interesting and very beautiful family of organisms, namely, two species of *Cupularia*, five of *Lunulites* and five of *Selenaria*. Of these four are living and eight fossil. The recent forms are all from the east coast of Australia. The fossils are chiefly from the Muddy Creek Miocene beds of Western Victoria, but the following South Australian localities have contributed to the list:—Mount Gambier, polyzoal limestone; Upper Murravian beds at Morgan, and the inferior beds at Blanche Point, Aldinga Bay. Australia has been already celebrated for being the only surviving home of the almost extinct genus of Lunulites; and it is interesting to observe that there is a new living form of that peculiar solid type, which has been figured and described by Busk. Our four fossil forms are different from those already known.

Both the living and extinct Cupularias are new forms of much interest, but the relations of the fossil species are remote to any living or extinct form.

There has hitherto been only one known species of *Selenaria*, occurring on the south coast of Australia. To this I am enabled to add two others, very distinct from their congener, and three fossil forms, all of extreme interest and beauty, and of a distinct type. One of them has a peculiarity in common with one of the new living species here described, that is in

the margined ribs of the under surface, but in all other respects they differ completely. As far as we know, none of the fossil species have living representatives, but comparatively so little is known of the living polyzoal fauna of our coasts that it would be quite premature to assert that any of them are extinct. It is, however, a remarkable fact that so far as we know there are very few living representatives of the rich polyzoal fauna of our tertiary beds. But I think it may safely be affirmed that any one seeing the present collection of fossil Selenariadæ would not hesitate to pronounce them Australian in character, and we may therefore *assume* that in Miocene times the polyzoa had already acquired an Australian facies. I have observed elsewhere that we could never expect to find in a fossil state such genera as *Catenicella*, *Menipea*, &c., as their horny joints could not resist decay, or would not fossilise. If, therefore, the Australian Miocene fauna was more like the present, much of the evidence of this must necessarily have perished.*

Inasmuch as there can be no definite line drawn between *Lunulites* and *Cupularia*, and because the latter generic name has been already employed in another way by D'Orbigny, I think it better to suppress the genus of *Cupularia* of Busk and regard them all as *Lunulites*. I do not think *Cupularia* can be maintained even as a sub-genus, because—as will appear when I come to deal with the genus *Lunulites* of Busk—the same individual may sometimes have the features of *Cupularia* in one part and those of *Lunulites* in another. In order, however, to correlate this part of my work with the labours of Busk I will keep the species separate according as they present the Cupularian or Lunulitic type.

Genus LUNULITES, *Lamx.* (*Cupularia* of Busk.)

Avicularia accompanying every cell, but not disposed in lines.

Recent Species.

LUNULITES (CUPULARIA) CRASSA, *Spec. nov.*

Pl. I., fig 1a—1c.

Zoarium rather large orbicular, somewhat depressed, roundly conical, solid, thick, dull yellow, margins thick elevated. Zoœcia pyriform rounded, but very little elevated. Mouth pyriform with a raised margin, outside which there are irregular pores. Vibracular pore round, conspicuous, above narrow end of mouth. Under surface of zoarium, with an oblique margin of cells, the rest of the concave surface a

*Since the above was written a most interesting discovery of fossil species of *Catenicella* has been made in the Geelong Miocene beds.

spongy texture of large rounded granules, with pores (one or two) between them. Diameter, about 10 millimetres; height, about 4.

Dredged in April, 1857, by W. S. MacLeay, at 70 to 80 fathoms, off Cape Three Points, and Port Stephens, N.S.W. About a dozen specimens are in the Macleayan Museum.

The size, thickness, and the peculiar spongy surface of this form would distinguish it without a knowledge of the cells, which are also different from any of the species described.

Fossil Species.

Lunulites (Cupularia) rutella, *Spec. nov.*

Pl. I., fig. 2a—2d.

Zoarium irregularly orbicular, thin, much depressed. Zoœcia squamosely radiating, oval, somewhat depressed above, but elongating below into a projecting overlapping somewhat narrow rounded edge. Lamina immersed with two large pyriform pores at each side below, and two or three small rounded ones above. Margins thickened and raised. Avicular pores numerous, much smaller than the cells, elongately triangular, rounded at the apex, and a distinct raised margin. The whole surface finely granular and shining. Under surface with broad very irregular undulating uneven radiating sometimes bifurcating faintly granular ribs.

Locality and Horizon.—Muddy Creek Miocene beds, near Hamilton. Upper Murravian beds; and lower Aldinga marls (Prof. Tate).

This is one of the most elegant of our fossil species. The openings are so large and defined that without the assistance of a lens they can be discovered. The avicular pores are sometimes in a line for a series of three or four, but they are always interrupted and never in a regular line like *Lunulites*. The cells are not quincuncially arranged, so that the generic position of this species would be very doubtful. The under surface is similar to *Lunulites aperta*, and quite different from the usual kind of ornament at this part of the zoarium among Selenariadæ.

Genus Lunulites, *Lamouroux.*

Cells arranged in more or less regular series radiating from the centre. Vibracula in linear series, alternating more or less regularly with those of the cells.

This definition, which is that of Busk, shows how very difficult it would be to draw a line between *Lunulites* and *Cupularia*. It seems to me that if the cells are quincuncially arranged the vibracular pores will not be in a line; but if not

quincuncially arranged the pores must be in a linear ser
Such a distinction is very arbitrary, and may vary in the s
species, or even in the same individual. I do not think
genus *Cupularia* can be maintained.

***Recent* Species.**

LUNULITES ANGULOPORA, *Spec. nov.*

Plate I., fig. 3a—3c.

Zoarium small conical white, rather smooth. Zo
minute, irregular, with an oblique mouth divide
portions; one half triangular, constricted in the
other semicircular—both with a raised margin
vibracular pores, which are long and narrow, and
area. The cells are obliquely placed; sometir
directions alternately. Base flat, with a mar
centre of irregular porous or spongy structu
well defined, occasionally with a calcareou
with a ring of five or six pores, and a
Diameter and altitude about equal, fron
metres.

Port Stephens, New South Wales.
Both the specimens in the Macleay
the details of the structure of cells v
It is remotely like Busk's *L. Philipp*
have been described and drawn from

Fossil Spec

LUNULITES APERT

Plate I., fig

Zoarium large, orbicular (?),
Zoœcia quadrangular, rather
Lamina, if any, worn away
raised, equally thick all r
Avicular pores oval, constri
margin pyriform. Under
undulating costæ.
The cells, pores, and
distinct from the living
specimen is very much
Locality and Horiz
Hamilton.

Lu

Zoarium large
crusting; in the

Zoœcia small round projecting and irregularly pitted, or porous. Mouth circular with a raised margin. Vibracular pore oblique, pyriform with a raised margin, and a conspicuous bar across the centre. Under surface finely radiately ridged, with a long narrow slit-like pore at the margin.

Locality and Horizon.—Glauconitic limestone, Aldinga (Prof. Tate). I have also found the same species in the lower limestone beds at Mount Gambier. It is decidedly the largest species known, and is easily distinguished by its peculiar vibracular orifice.

LUNULITES EXIGUA, *Spec. nov.*

Pl. II., fig. 7a—7c.

Zoarium very small, thin scale-like, slightly convex, but depressed. Zoœcia minute in regular radiating, sometimes bifurcating, raised rounded lines. Mouth circular, large. Avicular cells in grooves between the lines of cells, lanceolate. Base quite concave, with lines of projections exactly corresponding with the zoœcia and avicular cells.

This species somewhat resembles the following *L. cupola* in the disposal of its cells and the avicularia, but it has a concave base, and the shape of both zoarium and zoœcia are different.

Locality and Horizon.—White polyzoal limestones at Mount Gambier (Prof. Tate).

LUNULITES CUPOLA, *Spec. nov.*

Pl. I., fig. 5a—5c.

Zoarium small, nearly circular, roundly conical. Zoœcia oval, flat round the margin, and regularly convex in the centre. Mouth in the lower part neatly defined, horseshoe shaped, with two small shifting oval protuberances on each side; whole surface finely granular, edges overlapping the avicular grooves. Avicular pores parallel with the base of the cells, smaller than the apertures, elongately oval with a basal groove and two small processes projecting from the sides, so as to constrict the centre of the orifice, Base of zoarium quite flat, granular irregularly marked with grooves, which bifurcate at the edges, on which there are conical shaped hollows corresponding to half a cell area.

Locality and Horizon.—Muddy Creek Miocene beds, near Hamilton, Victoria.

Genus SELENARIA, *Busk.*

Only a certain number of cells, dispersed throughout the polyzoary, furnished with vibracula. The front of each cell

others arched above, contracted b
zoarium marked with grooves.

This definition applies almost exc
known to Mr. Busk. The cribrifo
not present in the species descri
character is confined to the few
pores.

Recent

SELENARIA PUNC

Pl. II., fi

Zoarium small orbicular or
what thick, margins rounded
cells in worn specimens, of
surface rough and spongy
angular at the sides, arched
the form varies. Surface
rather large at base of cell
rarely three, round pores
cells, ovate, rounded, ad
mouth of underlying cell.
mouth of cells, somewhat
surface of zoarium form
grooves between, with
Some of these costæ co
intercalated between,
fine or obtuse points
they have the appear
Diameter of zoari
three to four.
Dredged off Cape
The small cells
sufficiently distinc
the fossil *S. parvi*

S

Zoarium sma
margins flatte
centre; colou
Zooœcia hexa
ing as seen
scales. De
covered wi
rangular, v

sometimes with an avicular opening beneath, with well-defined raised margin. Under surface of zoarium with undulating, broad, flat, punctate costæ, bifurcating, with short blunt ribs intercalated, and all circumscribed by a distinct narrow raised margin. These costæ seem to correspond with the width of the cells, and on the edge they often correspond with the limits of a marginal cell.

Diameter, three and a half to six millimetres ; altitude, one to two.

Dredged at 71 fathoms off Cape Three Points.

This species is distinct from *S. punctata* in many respects, but particularly in the one pore at the mouth of the deep cell, and in the margins round the flattened ribs at the side.

Fossil Species.

SELENARIA PARVICELLA, *Spec. nov.*

Pl. II., fig. 10a—10c.

Zoarium large, irregularly orbicular (?), very thin, depressed. Zooœcia small, horseshoe shaped, the round end below ; walls thick, margins raised, lamina not visible. Avicular cells elongately pyriform ; the apex above, narrow, immersed, with broad inner margin, very long, nearly equalling two cells. Under surface with numerous radiating depressed ribs, not bifurcating, but with undulating margins ; and in the centre a single row of large pores, irregular in shape, size, and distance from one another.

The cells in this species vary much in size, and the peculiar vibracular cells are different in size and shape from any other species.

Locality and Horizon.—Muddy Creek Miocene beds, near Hamilton.

SELENARIA CONCINNA, *Spec. nov.*

Pl. II., fig. 11a—11e.

Zoarium small, thin, orbicular, very slightly convex, sometimes almost flat. Zooœcia quite concave. semicircular, the upper angles often circumscribed by the neighbouring cells. Surface finely granular, waxy, shining. Aperture elongately semicircular, the rounded basal edge encroaching on the low margin of the cell. Avicular cells about the size of the aperture, very narrow, oblong, or triangular, with the base above, the edges studded with very fine teeth. Under surface with radiating, flat, granular ribs, thickly beset with irregular

pores; between these ribs there are always fine rais
which branch two or three times towards the margin.
Diameter, four millimetres; altitude, one millimetre.
A peculiar and very neat form, very granular, and
granules projecting on the edges of the zoarium,
asperities. The avicular cells are edged with fine, sha
spiny-like teeth, which almost close the aperture of the cel
This structure is quite unique in the genus. The zoœcia ar
all depressed, and do not project in any way, or overlap one
another; but the surface is pitted, and appears without a lens
somewhat like the top of a thimble.
Locality and Horizon.—Muddy Creek Miocene beds, near
Hamilton.

SELENARIA ALATA, *Spec. nov.*

Pl. II., fig. 12a—12c.

Zoarium rather large, orbicular, moderately convex, solid;
edges thick, spongy. Zoœcia elongately semicircular, over
lapping squamosely; margins distinct, raised; area depressed
aperture large, narrowed above by triangular ala at each si
Avicular areas larger than zoœcia, very few in number, wi
large ear-shaped pore in the midst of the area. Under su
very finely punctuate, with a few radiating fine grooves, f
two or three times towards margin, between which t
many large pores in a double or single line of irreg
and intervals.
Diameter, rather more than 6¼ millimetres;
ceeding 2¾.
The cells are a little more constricted than
sented in the drawing, and this I believe to b
between this species and var. a, which I c
lata.

SELENARIA ALATA, var. L
Zoarium small, orbicular, solid, n
younger specimens most so, base fl
margins raised; centre depressed
square opening with the angles r
and the sides slightly constric
margin. Far back in the openi
pore. The whole surface gra
in number, something like
Under surface with deep ir
sizes forming a pattern ve
Diameter of zoarium,
The shape of the ape

Locality and Horizon of the species and variety.—Muddy Creek Miocene beds, near Hamilton, Victoria.

EXPLANATION OF PLATES.

Plate I.

Fig. 1. *Lunulites (Cupularia) crassa:* *a*, zoœcia, magnified; *b*, portion of base, magnified: *c*, zoarium, natural size.

Fig 2. *Lunulites (Cupullaria) rutella:* letters as above.

Fig. 3. *Lunulites angulopora:* letters as above.

Fig. 4. *Lunulites aperta:* letters as above.

Fig. 5. *Lunulites cupola:* letters as above.

Fig. 6. *Lunulites magna:* *a*, *b*, zoarium, natural size; *c*, zoœcia, highly magnified; *d*, outline of base, natural size.

Plate II.

Fig. 7. *Lunulites exigua:* *a*, zoarium, much magnified; *b*, zoœcia, highly magnified; *c*, part of base, magnified.

Fig. 8. *Selenaria punctata:* *a*, zoœcia, and *b*, portion of under surface, much magnified; *c*, sections of two zoaria, natural sizes.

Fig. 9. *Selenaria marginata:* *a*, zoœcia, and *b*, portion of under surface much magnified; *c* and *d*, section and outline of zoarium, natural sizes.

Fig. 10. *Selenaria parvicella:* *a*, zoœcia, and *b*, portion of base, magnified; *c*, zoarium, natural size.

Fig. 11. *Selenaria concinna:* *a*, zoœcia, and *b*, portion of under surface, both magnified; *c*, a vibracular cell showing the peculiar teeth-like projections, much magnified; *d* and *e*, outline and sections of zoarium, natural sizes.

Fig. 12. *Selenaria alata:* *a*, zoœcia, highly magnified; *b*, part of base, magnified; *c*, zoarium, natural size.

RED RUST:

ITS NATURE, APPROXIMATE CAUSES, AND PROBABLE CURE.

By OTTO TEPPER, F.L.S., London; Corresponding Memb

(Abridged.)

[Read November 1, 1879.]

The subject under consideration divides itself natur
various questions, viz.:—

What is Red Red Rust, and how is it produced?

What laws govern its development, and the g
fostering plant?

What will check the one and promote the othe

That Red Rust, or mildew, is a fungus, al
smut, brand, &c., has been proved and known
reddish dust, which furnishes the name, is th
the spores or seed germs of the fungus, a
denotes the last stage of its development
thereof. The first plants upon which it a
observed by me) are self-sown plants of
wheat, in the order they are named, the
and the latter not necessarily injured
that this, the first stage (for accordir
are three or four) only attacks the
inconspicuous manner, the few s
assigned to different causes by t
the sown crop be attacked, the i
same order—first by faint minute
sheaths, then on the portion of
These gradually augment, at
or outer skin into minute
ances plainly discernible
finally burst almost spon
limited localities, accord
Then only, when the fa
observer, is it noticed;
and nothing can stay

Whence did it com
plant? To answer
the growth of fun

the extent of an inch, and are, therefore, singly quite invisible to the naked eye. Again, they are produced in such inconceivably large numbers that millions are said to be evolved from a single plant. Some float in the air constantly, and at all heights, assisting—Prof. Huxley suggests—in causing the blueness of the sky. Thus they are spread over the world, only awaiting a favourable opportunity to alight on a suitable host, where they germinate, grow, and give birth to millions more. Ordinary terrestrial heat little affects these spores, but myriads perish by moisture and warmth, causing germination when not near or upon a congenial plant; or the temperature may be below the limit proper to their development; or the cuticle of the plant may be too hard or too tough to be penetrated, for fungoids of this class only develop within the tissues of their hosts. Before describing the manner of the germination of spores, which differs widely from that of seeds proper, it must be remarked that many fungoids, as well as numerous animal parasites of low organization, undergo a two-fold development known as "alternation of generation," or "metagenesis," to which our Red Rust very probably is also subject. In this the rule that "like produces like" does not hold good, the spores of a fungus of definite forms infecting one plant not propagating upon the same, but upon a totally different one, and developing into a growth more or less different from its progenitor. The spores of this last, however, return to the former host and produce the original fungus in an analogous matter to "measles" in pork, entering the human frame and developing into the tapeworm, while the eggs of the latter swallowed by pigs infect them with measles. The best known instance of this, according to some authors, is that of the "fœtid smut"—*Tilletia caries (Uredo fœtida)*—which is said in its second form to propagate upon *Berberis vulgaris*, L., the eradication of this shrub in the vicinity of cornfields being followed by almost total disappearance of the said smut. The Red Rust appearing to belong to this class of fungoids, its second host is seemingly the so-called "barley grass," an introduced plant—(other grasses, several acacias, especially a species with greyish-green velvetty leaves growing near Callington, Truro, &c., are likewise strongly suspected)—which of late years has largely supplanted the native grasses, and upon which the rust appears before any other plant in the form of numerous brownish spots upon the leaves. This generally takes place in July, August, or September, sometimes earlier, sometimes later, according to the general temperature of the season. Should the ground be very moist, the weather at the time be

so; the ears, husk, and skin of the grains are formed, waiting to be fertilised and filled, when the fungus steps in and impedes or intercepts the process.

Its agents, the mycelium threads, are widely dispersed through the whole plant; they appropriate from the sap the ingredients suitable for themselves, swell greatly, and with the multitude of sporangia forming, choke the channels of the sap, preventing its ascent to the head, where it is required, and finally bursting the skin, the plant is prematurely killed, while the fungus, shedding myriads of spores, has completed its own cycle.

Should cold, calm, rainy weather prevail at the time the spores are shed from the intermediate plant (or, on the other hand, those of the first stage on the wheat or other plant), the chances are that the greater number of the spores will be washed down into the soil and perish for want of proper nourishment, few only reaching their destination to do any perceptible harm, although the wheat might be in a fitting condition to receive them. Again, should dry weather prevail, with only sufficient moisture in the ground to keep the wheat in a healthy state, the stalks, &c., would be healthy and able to prevent the entrance of the fungi. Yet, a few always escape destruction, or find a suitable host, and a single spore produces a progeny in one season to infect, under favourable circumstances, a whole field in the next.

The reason why barley, oats, and some other grasses are not affected at all, or only to a slight degree as far as their seeding is concerned, is to be sought for in the fact that their grains are nearly perfected before the fungus interferes by choking the sap-canals, the latter thus only appropriating their surplus of sap, while in the case of the wheat the fungus comes first. Another cause may be that neither barley nor oats have been so highly refined through artificial selection as wheat, and thus remain hardier.

The first time the writer observed Red Rust was in 1854-5, near Lyndoch, extending over irregular patches of ground of considerable extent. Where observed it developed most in soils rich in humus and clay, least on stiff loamy soils; again more so on land ploughed shallow than on deeply-ploughed ground; but this, most likely, depends upon the subsoil, which, at the spot referred to, was beyond the reach of the plough, and consisted of stiff yellow clay. Since then it has been noticed nearly every year to a greater or less extent, the writer having lived constantly among farmers and farms.

In 1862 rust was observed in the neighbourhood of Mount

Gambier, chiefly on rich, loose, black soil with much lime, limestone forming the subsoil, but very little could be noticed on sand. What is most notable is that a variety of wheat, called "creeping wheat," distinguished by very stiff, glassy, upright stalks, appeared to be much less affected, if at all, than any other kind. It also was the latest in ripening. These facts probably point an important moral.

In 1871-2 rust prevailed much in Monarto, chiefly on the best loamy or clayey soils with limestone or clay subsoil, while splendid grain was obtained on patches of very sandy soil, ploughed and sown hurriedly for want of time.

At New Mecklenburg wheat was found as rusty as elsewhere near a salt creek, the soil being surcharged with saline ingredients. At Ardrossan, Yorke's Peninsula, all the crops were much affected with rust in the past season, and no difference was observable between those bordering the seashore and those some miles inland. The soil is abundantly supplied with salt and lime.

The above observations are intended to show that rust occurs equally on all soils, and under very varied circumstances respecting locality and situation. They seem to prove that the occurrence of the fungus does not depend either on the soil or local circumstances, but more likely upon—(*a*) Particular atmospheric conditions. (*b*) The structure of the wheat-plant. (*c*) The constitution of the soil (that is the soluble salts it contains); and suggest the direction in which the remedies lie.

In respect of the first the power of man is inefficient to do much, except in so far as by planting forest trees extensively (say a strip around each field) he can, to a considerable extent, regulate the moisture in the soil, as they promote the infiltration and retention of the rainwater, and protect the land from injurious winds.

The structure of the plant and the constitution of the soil are much more in the power of man. What promises by far the best results is the production of a wheat plant combining a hard smooth stalk and a full fine grain. This will depend on the ingredients of the soil, the constitution of which is inevitably changed for the worse by cropping year after year, without returning to the soil in a suitable form the ingredients removed by the crops. To determine these is the province of the agricultural chemist. Wheat and all other grain crops require a great number of substances for the production of seeds; the absence or insufficiency of *any one of them* will cause weakness and sickening of the plant, expose it to the invidious attacks of its enemies, and ultimate decay and death. For the building up of the stalks, leaves, and husks soluble silicates besides the carbon (derived chiefly from the

atmosphere) are required. Their presence depends largely on decaying vegetable matter in the soil. Sulphates and phosphates of potash, soda, and lime, &c., are wanted for the formation of seeds.

Seeking for a remedy in another direction, there *may* be discovered a substance which, when applied to the soil, or the seeds, and imbibed by the plants, will act adversely to the growth of fungoids, in the same way as bluestone (sulphate of copper) checks the "Dust Brand" *(Ustilago segetum)*. Thus in "Rust, Smut, Mildew, and Mould," Mr. C. Cooke says, at page 81, "the spores of many species of fungi will not germinate after saturation with certain chemical solutions. One of the most successful remedies, and easy of application, is a strong solution of Glauber's salts, in which the seed corn is to be washed, and afterwards, while still moist, dusted over with quicklime. The rationale of this process consists in the setting free a caustic soda by the sulphuric acid of the Glauber's salt combining with the lime, and converting it into sulphate of lime. The caustic soda is fatal to the germination of the spore of 'bunt,' and probably also of smut and rust."

NOTES ON THE COMET OF FEBRUARY, 1880.

By C. TODD, C.M.G., F.R.A.S., Vice-President.

(Read March 2, 1880.)

[Plate III.]

You will no doubt expect to receive from me some account of the fine comet which during the first half of last month formed so conspicuous an object in our evening sky. I regret that I have not very much to tell you about it, and I fear I cannot tell you much more than you already know; but it is only proper that what little I have to say should appear on the records of this Society. Owing to the extreme faintness of the nucleus, and its low altitude at first, very few measurements could be taken, and these extend over so short an interval as to afford no data for determining even approximately its orbit. My friend Mr. Ellery succeeded in getting measures on February 9, 10, 14, 15, 16, and 17, and glimpsed it on the 6th and 13th. I obtained measures on the 12th, 13th, 16th, and 17th, and I just glimpsed it on the 18th; but thin clouds and bright moonlight prevented any observations of its position being taken. This, I believe, was the last occasion on which it was seen in Australia, the increasing moonlight on the next evening completely blotting out so faint an object, although I made a long and keen search for it with the telescope directed over the spot in the sky in which I knew the nucleus to be situated. Mr. Russell, the Government Astronomer in Sydney, who possesses a splendid equatorial, with an object glass of over eleven inches aperture, by Schroeder, only saw the nucleus twice for short intervals between clouds on the 13th and 14th; and Mr. Tebbutt, of Windsor, N.S.W., whom you all know as an ardent and experienced observer, writes me to say that owing to clouds he has been unable to see the nucleus at all. I mention these circumstances partly because you will no doubt have seen remarks complaining of the little information I gave the public respecting the comet, and reproaching me for not sooner detecting the nucleus. I think what I have told you will suffice to show that the nucleus was not a very easy thing to see, especially when it was low down in the mists of the horizon, and the atmosphere on the horizon

was very thick and unfavourable for the week or ten days after the tail was first seen. It happened, too, unfortunately that I was all alone; the Assistant Astronomer, Mr. Ringwood, being absent in Tasmania, and only returned on the morning of the 16th. On the five evenings on which I saw the nucleus it was too faint to bear any illumination of the field, and in taking the measurements I had to bring it to the edge of the comb of a bifilar micrometer, using a very low power; the observing-room was also kept dark.

In the accompanying map (plate III.) I have laid down approximately the path of the comet between the 2nd and 17th of February, and the position of the tail amongst the stars. The first thing that will strike you on looking at this diagram will be the rapid extension of the tail, which, within a few evenings from its first appearance, lengthened out from an altitude of about 15 deg. or 20 deg., up to within a short distance of the zenith. The rapid manner, too, in which it finally faded away, leaving the small faint nebulous nucleus with scarcely a trace of a tail after the 14th, was very remarkable.

On the 16th and 17th I could see no tail through the equatorial, the nucleus being reduced to a mere hazy speck. The length and brightness of the tail led me to expect a bright and large nucleus; but on the 6th, when it was first caught sight of by Mr. Ellery, it was so faint as to leave some doubts as to its identity. Mr. Ellery, in his telegram to me, says:—"Faint nebulous point, perhaps nucleus, observed last night (the 6th) R.A. 22° 48′, dec. 32° 36′."

The tail I considered was brightest on the evening of the 2nd, when I first saw it. It then appeared as a narrow auroral-like streak of light, extending from the mists on the horizon, perhaps a little N. of S.W., up to and passing nearly through *Delta* 1 and *Delta* 2, and *Beta* Gruis, the upper extremity, from about *Delta* Gruis, curving sharply to the south. On the following evening, the 3rd, clouds hung about the S.W., obscuring the view; but as they cleared off, the tail was well seen. It was somewhat broader than on the 2nd, and perhaps a little brighter than the Nubecula Minor, but not so bright as the larger Magellan cloud. Roughly speaking, the tail had shifted about 3° to the north, the stars *Theta* and *Iota* Gruis lying on the northern edges of the tail, which in its curvature was nearly concentric, with a line passing through *Delta* 1, *Delta* 2, *Beta*, and *Epsilon* Gruis, extending, as far as my eye could trace it, to an altitude of about 27°. A low bank of cloud cut off the view of the lower portion or head of the comet, which was probably not far from *Beta* Pisces Australis, at the time hid by cloud. I see I made a note that the tail was brighter than on the 2nd, but this I think was due to its greater altitude, its

greater breadth, and perhaps also to contrast with the dark clouds. I saw it on the 2nd, first in strong twilight, and for some time took it to be an auroral streak, till its fixity and freedom from pulsation indicated its true character. I may here say that the comet appears to have been seen by several persons on Sunday evening, the 1st, and by Mr. Blessing, of Seppeltsfield, on Saturday, the 31st of January.

On the 4th I saw the tail as early as 8 o'clock, and later, when the twilight had died out, it was very bright. I could trace it down to *Beta* Pisces Australis, which star was near the extremity, on the northern edge; but I thought wholly immersed in the tail.* In this position *Beta* Pisces Australis was probably mistaken by many persons for the nucleus, of which, however, I could see no trace. The tail could be followed nearly up to and pointed directly towards *Eta* Phœnicis, or to an altitude of 35°. Better eyes could probably trace it further. *Theta* Phœnicis was within, but nearly on the northern verge, and the tail was broadest and brightest a little below that star —about 1½° wide, gradually tapering towards each extremity. The tail was about as bright, or a little brighter, than the smaller Magellan cloud, which in structure it much resembled, and could be seen much better with the naked eye than through a telescope.

On February 5 the tail was not so bright; first seen about 8.10; later it reached up to *Zeta* Phœnicis, say 40° or beyond, passing through *Epsilon* Phœnicis, the head being to the south of Fomalhaut. It was only slightly curved to the south, the upper end straightening as the tail swings over to the north.

Feb. 6. Fainter and less curved. Now extends to *Chi* Eridani, perhaps further. Air thick on horizon.

Mr. Mann, telegraphing from Mount Gambier, thus describes its appearance this evening:—

"Feb. 6, midnight. Beautiful clear night. I went to the top of the mount near the lakes to observe the comet. It has no nucleus, but tail fades away at some distance above the horizon (*i.e.*, cannot be traced down to horizon). At 10h. 30m. tail scarcely visible, and gradually faded away; position, S.W. by S. When at its brightest about 9 o'clock it extended over about one-fifth of the sky. At no time was the tail well

* Dr. Bone, of Castlemaine, in Victoria, claims to have seen the nucleus with a field-glass on the 4th, and gives its position R.A. 22h. 49m. 5s., dec. 33° 35′. This would bring it close to *Gamma* and *Delta* Pisces Australis (R.A. 22h. 45m. 38s., and 22h. 49m. 5s., and dec. respectively 33° 11′ and 33° 30½′). The position given by Mr. Ellery on the 4th was R.A. 22h. 48m., dec. 32° 36′. Dr. Bone's position is either wrong, or he must have mistaken some star for the nucleus, and if so it was probably either *Gamma* or *Delta* Pisces Australis.

The comet was seen this evening (6th) at the telegraph station on the River Katherine, in the Northern Territory, by Mr. Murray; also at Pine Creek, and by Mr. Little at Port Darwin. I telegraphed its position to Singapore, but it was not, I think, seen there.

On Feb. 7 the tail was much fainter and reduced to a thin nebulous streak, extending from a little above Fomalhaut up to *Kappa* Eridani, passing through *Alpha* Phœnicis.

Feb. 8. Comet fainter, and now has a slight curvature northwards. Can be traced from a little north of Fomalhaut, past and north of *Alpha* Phœnicis, and *Gamma* Phœnicis being on the northern edge, up to and pointing a little north of *Kappa* Eridani. I lost it a little beyond that star, but Mr. Cooke could trace it up nearly to the zenith.

Feb. 9. Looked carefully for nucleus, but could not see it. A bank of stratus below Fomalhaut on S.W. horizon, and atmosphere thick. The tail now passes a little north of *s* and *e* Phœnicis, a little south of *Delta* and *Epsilon* Eridani, above which I lost it, but my young assistant, Mr. Cooke, who has very sharp eyes, said he could trace it nearly up to the four stars, *Alpha*, *Epsilon*, *Beta*, and *Gamma* Columbæ (a short distance west of the zenith), towards which it points.

No special notes were made on the 10th and 11th, except that the tail was rapidly getting fainter.

On the 12th I succeeded in detecting the nucleus, and got some differential measurements in R.A. and Dec., comparing it with a star of 5½ magnitude, No. 103 in the British Association's Catalogue (29 in the Melbourne Catalogue), and a small star of the 10th or 10-11th magnitude, being one of four small stars forming a pretty trapezium in Sculptor, which were in the same field as the nucleus, and to the south of the comet. The nucleus was a faint nebulosity. I could see no central condensation, and could only just trace the tail in the field of the equatorial finder, although it could be seen with the eye as a faint streak of light in the sky. At 10h. 1m. the comet followed B.A.C. 103; 2m. 22s. and 14m. further south in declination. Its approximate position, therefore, was R.A. 0h. 24m. 18s.; Dec. 33° 55′ south.

On the 13th I again got some good measurements, using a star of the 8th magnitude, which I have not found in any catalogue, and whose place, therefore, will have to be obtained with a transit circle on the meridian.

The comet at 9h. 27m. followed the star 2m. 24s., and was 10′ to the south in declination.

On the former evening it was compared with B.A.C. 458, from which its approximate position was found to be

R.A., 1h. 29m. 26s.
Dec., 31° 21′ south } at 10h. 1m.

On that evening I thought I could occasionally see a slight stellar condensation, but this was not confirmed on the following evening, when its appearance in the 8-inch equatorial was that of a faint nebulous telescopic comet, without any defined nucleus. As I have before said, it would bear no illumination of the field, and the measures were taken at the comb of the micrometer. The tail could at times be just traced in the field as a slight elongation of the nebula. The reference star used on the 17th was Lacaille No. 522. It cannot be found in any other or modern catalogue, and its position, therefore, requires verification. The approximate place of the comet deduced from fourteen measures in R.A, and ten in declination was—R.A., 1h. 41m. 16s.; Dec., 30° 18′ at 10h. 5m.

I have been unable to identify the comet with any previous one. No orbit has been calculated, and in fact the few observations we have obtained are insufficient to give more than a very rough approximation to its path. Whether, therefore, it is a new friend or a regular denizen of our system I cannot say.

With comets, as you are aware, the space through which we can follow them is often too limited to enable us to deduce an elliptical orbit. A parabola, and in some instances an hyperbola, will satisfy all the observations, and in that case no period of revolution can be obtained; in other words, we cannot say whether the comet will soon return to us, or whether it will go on to other systems far away in the infinite space by which we are surrounded. We are, however, helped by knowing the velocity of its motion. For instance, it has been shown that if a comet at a distance from the sun of about 92,000,000 travelled at a rate of 26 miles a second, it would describe a parabola; and, therefore, unless arrested in its course by the action of one or more of the larger planets, it would never return.

Many comets to which a parabolic orbit has been assigned no doubt move in very elongated ellipses, and will and do return to us after long intervals.

Now, the position of a comet's orbit in space is fixed:—

1. By the inclination of the orbit to the ecliptic.
2. The points of intersection with that plane—*i.e.*, the longitude of its ascending and descending nodes.
3. The longitude of perihelion.

To which may be added as a further means of identification, whether the direction of its motion is direct or retrograde.

In catalogues of comets these elements are given, and when any new comet comes into view, and the elements of its orbit are determined from the observations made, we can compare these elements with those of older comets, and thus ascertain whether it has ever been seen before.

Bright comets have been regarded by the ancients with awe and dread, and thus influenced they have fortunately left us pretty reliable records of their apparitions, and from these Mr. Hind was able to trace successive appearances of Halley's comet—which we last saw in 1835 and '36—as far back as 11 B.C., and in A.D. 65 it hung as an avenging sword over Jerusalem, then besieged by Titus.

In like manner the splendid comet of 1680 was identified, with some degree of probability, with the comets of 531 and 1106, and the year of Cæsar's death.

With regard to the comet of this year I find that the longitude of its ascending node is about 123°, and the inclination to the ecliptic about 38°. It probably passed its perihelion at the end of January. Its motion is direct.

Mr. Jones, of Gawler, says he first saw what he believes to be the same comet some weeks earlier. It was then—(I use his own words as published in the papers)—mistaken for a nebulous star about 8° east of the Nubecula Minor, and that three days later the same object was 2° to the eastward, had become brighter, and had assumed an oval configuration. I fail to identify this object with our recent visitor, and must express my regret that Mr. Jones did not announce his discovery of a new comet at the time. I shall be glad now to receive particulars of his observations. Mr. Jones further appears to think that the comet of 1880 and Faye's comet are one and the same. Now, I was fortunate enough to observe Faye's comet in 1850 and 1851 at Cambridge. We were the first to re-discover it on November 28, 1850, and followed it up till the month of March following. It was excessively faint, even through the twelve-inch Northumberland telescope, and was, I think, seen at only two other observatories—Cambridge, in America (where they got two observations), and at Berlin. It bears no resemblance to the late comet, and has a different orbit. It reaches its perihelion in November this year.

ON THE CHARACTERISTICS AND DISTRIBUTION OF THE NATIVE AND NATURALISED PLANTS ABOUT ARDROSSAN, YORKE'S PENINSULA.

By Otto Tepper, F.L.S., Corr. Member.

[Read April 6, 1880.]

[Plate IV.]

At the desire of the eminent botanist, Baron F. von Mueller, K.C.M.G., M. & Ph. D., F.R.S., Melbourne, I commenced in the second half of last year to utilise some of my leisure by collecting the plants of the neighbourhood of Ardrossan, with the view thereby to elucidate the floral aspect of the Peninsula, as a narrowly circumscribed and almost isolated area. Being limited in time and means of locomotion, the area examined is necessarily small, mainly comprised within a radius of three or four miles. A few excursions have been made to Yorke Valley (two miles E. of Maitland) near the middle of the Peninsula, and one to Kilkerran and the West Coast, in which I was greatly assisted by Mr. Wundersitz, to whose kindness my best thanks are due. Another excursion was made to Muloowurtie and Pine Point, but rather too late in the season. A few plants were obtained from Kalkabury, 14 miles N.W. from here.

The dried specimens were forwarded to Baron F. v. Mueller who most obligingly named them, and afterwards revised t[he] arrangement. Considering the labour this entails, an[d] increased scientific value it gives to the work, great th[anks] due to the honorary member.

The accompanying "List of Plants" represent[s] of the undertaking; but the whole of the A[bove] omitted on account of incompleteness, with [the exception of] the Filices and Musci (four species), wh[ich] that occur in the area examined.

To the names of the plants are [added] indicating the geological formatio[n]

in the table showing their numerical relation. The term "coast" includes the sea-beach as well as the adjoining plain. The soil of the latter consists everywhere of an arenaceous, somewhat saline clay, derived partly from tertiary and partly from primary, or even plutonic rocks, and covers (in variable dimensions) loose, globular limestone concretions. Some plants, characteristic of certain formations, mark this conspicuously; for example, the native tobacco, *Nicotiana suaveolens*, Lehmann, which flourishes on soil derived from primary rocks in the North, occurs here among the sandstones and marbles of the hills near Ardrossan, but accompanies the debris along the gullies to within a few yards of the sea shore. This seems the case also with other formations, which largely explains the sometimes strange intermixture of plants. But it appears to me that plants prefer certain rocks less for their chemical than for their physical properties; thus plants affecting tertiary soils, such as *Calycothrix tetragona* seem to cling as well to the newer, loose aggregated limestones as to the silicious grits, while the dense travertines are associated mostly with the same plants that grow beside primary conglomerates, schists and granite. Of these I mention *Myoporum viscosum* and *Dodonæa viscosum*. By the term "general" (G.) those plants are denoted which flourish indiscriminately on all formations, provided the conditions of the surface soil be favourable to vegetable growth. Examples in point are our two principal mallees, *Eucalyptus oleosa* and *E. gracilis*, which cover the greatest area of the Peninsula. Others are most grasses, several Goodenias, *Dampiera rosmarinifolia*, *Bursaria spinosa*, *Wahlenbergia gracilis*, and almost all introduced weeds.

A few words about the lateral arrangement of the geological features may not prove superfluous in rendering the following remarks more lucid. The appended diagramatic section (Plate IV.) illustrates roughly the configuration of the Peninsula from Ardrossan westward to Point Pearce Peninsula. The distance from sea to sea is about 26 miles, and the greatest elevation is attained by the double ridge at Maitland, between which is Yorke Valley. The heights in the sketch, which are much exaggerated, are about 300 feet in elevation, those at Maitland probably above, and those at Ardrossan below the average. The chief geological features are indicated in the sketch. The width of the Ardrossan coast-plain is about a mile; that of Kilkerran two or three miles. The tertiaries form narrow bands on the east coast, not exceeding a few hundred yards in width, near the summit of the hills and following their convolutions. Those on the west coast are only inferred from the vegetation, &c., and form a belt some two or

three miles across. The soil covering the several formations is everywhere a more or less sandy clay, rarely replaced by pure sand, with this difference in the substratum, that the loose limestone concretions on the newer are replaced by a solid travertine on the older formations, the respective rocks only protruding at rare and wide intervals, just about sufficient to surmise the real nature thereof. It will be noticed by the diagram that the primaries occupy by far the largest area. They consist chiefly of granite, gneiss, quartzites, sandstones, and conglomerates from the Ardrossan to the first medial ridge. This fact partly accounts for the monotony and poverty of the vegetation, especially if it be remembered that the physical properties of the limestones favor a rapid percolation of the rainwater, thus producing a scarcity or rather absence of surface moisture. At Yorke Valley and west of Maitland a more tenacious and retentive clay prevails (probably derived from decaying *slates*), and consequently vegetation is much more luxuriant.

A few words on the temperature and other meteorological relations may not be amiss. As to the first, the observations scarcely extend beyond the neighbourhood of Ardrossan, and appears to be similar as at Port Adelaide and the Semaphore. In winter it is mild, frost is scarcely known, and the thermometer is seldom less than 55° F. in the daytime. In summer it has been observed as high as 116° in the shade (19/1/80), but the nights are always cool. The annual rainfall is about equal to the average of the province; rain falls frequently, but generally light, and of short duration. The winds seem more regular than on the main land. During the warmer season the cool south-east is the most prevailing; it is ever accompanied by dry and fair weather. In winter and early spring the south-west bears sway, generally dry; it sometimes brings heavy showers, and is always cold and bracing. The north-west winds are not very frequent, even in summer, when they are as hot as elsewhere; but in their train ever comes a speedy change and often rain; in fact, they are the true rain winds, as far as steadiness and continuity goes. The rarest winds are those from the east, very cold and cutting, and when accompanied with rain Australians *do* feel it cold. The changes in the weather, in the whole, appear to occur very regularly in the following sequence:—S.E., cool, fair, dry; E., cold and dry, sometimes drifting rain; N.E. and N., hot, sultry, dry, cumulus clouds gathering, either followed by steady rain, the wind gradually shifting through W. to S.W., with the rain breaking up into showers, frequently very heavy; or the wind suddenly shifting to the S.W., driving clouds of dust before it, and cooling the air within an hour or less from 116° down to

70° or less, in which case no rain follows except some light local thundershowers.

Whirlwinds are very rare about Ardrossan (this place is about 45 miles north-east of Port Adelaide).

During the prevalence of north-east and north-west winds the shores of the mainland can be plainly discerned, sometimes in curiously distorted outlines (25th August, 1879), and then the Port Adelaide Light is seen distinctly at night, which is not the case when the south-east, south, and south-west winds blow. The distance between the shores of St. Vincent's Gulf at Ardrossan varies from 20 to 35miles.

The total number of species contained in the list amounts to 363, exclusive of eight remarkable and well-defined varieties, comprised in 206 genera and 67 orders. Most of them have been gathered around the port of Ardrossan. Of those obtained elsewhere, the name of the locality has been appended to the name; thus 30 are recorded as peculiar to Yorke Valley and the adjoining hills to the east; twelve from Kilkerran; nine from Muloowurtie; and twelve from Maitland Road, by which is meant the low tract of ground between the Ardrossan and Yorke Valley ridge of hills.

The following table indicates the geological distribution of plants, according to the present state of inquiry:—

Formation.	Abbreviat.	Dicotyled.	Monocotyl.	Acotyled.	Total.
Coast and Coastplain .	C.	74	14	1	89
Coastplain & Tertiaries	C. and T.	27	12	0	39
Tertiaries	T.	21	4	0	25
Tertiaries & Primaries	T. and P.	32	3	0	35
Primaries	P.	81	11	1	93
Common to all, general	G.	70	19	2	91
Uncertain	—	1	1	0	2
Total	.. ..	306 incl. 8 var.	64	4	371

It will be seen that the coastlands furnish the greatest number of species, viz., 208, or about 61 per cent.; the tertiaries the smallest, with 184, and the primaries with 204, seeming somewhat richer. But the aspect changes, when we consider the respective areas occupied. Then we see at a glance that for any given *equal* extent the tertiaries present the greatest variety, especially if we consider the eastern coast-*plain* as belonging to the tertiaries *under the influence of the*

sea air (for which there are good reasons). Under this view the scantiness and monotony of the primary regions will fully reveal itself, as many of their peculiar forms of vegetation are very local, and frequently of solitary occurrence.

The aspect of the plant world of Yorke's Peninsula in the whole much resembles that of portions of the Murray Scrub between Callington and Swanport, and bears a decided desert character between Ardrossan, Yorke Valley, and Kalkabury, and again some portions of Kilkerran, brought about by the total absence of natural springs and flowing water, and the permeability of the soil. The coast-plain and other open patches are thickly studded with large tufts of grass-like *Cyperaceæ* and *Xerotideæ*. The most common is *Cladium lanigerum*, with cylindrical, needle-like, pungent leaves, associated with four species of *Xerotes* and one of *Lepidosperma* (undetermined), the latter distinguished from the preceding by its flat, leaf-like flower-stalk. The most common of the *Xerotids* is *X. effusa*. All these are almost useless as food for domestic animals, and lend to the landscape a weird, forbidding aspect. Among their tufts other grasses find a precarious domicile, of which *Stipa scabra*, *S. crinita*, *Danthonia penicillata*, *Poa caespitosa*, and *Agropyrum scabrum* are the most conspicuous, together with the introduced *Festuca bromoides*, *Koeleria phleoides*, and *Hordeum murinum*. *Anthistiria ciliata*, the "kangaroo grass," is in the whole very scarce. Wherever a fire sweeps away the scrub, *Stipa semibarbata* and *S. aristiglumis* appear in profusion, often growing a stalk three to five feet high, producing a singular effect at certain seasons by their large waving seed-plumes. During the season of spring these grasslands are enlivened by the thousands of yellow and white flowers of many Composites, Goodenoviæ, and Orchids, the blue of *Wahlenbergia gracilis*, the blue or pink of *Dampiera rosmarinifolia*, and many others; few only, among which is *Stackhousia linarifolia*, being at all remarkable for any pleasant scent. Of shrubs, dotting the open country near Ardrossan, &c., the most remarkable are the low, dense *Styphelia patula*, with dark green, glabrous, myrtle-like leaves and red edible berries; *Hakea rugosa* and the unavoidable *Bursaria spinosa*, with its large white clusters of snow-white flowers, but very spiny branches.

Grevillea Huegeli and a variety of *Eremophila Brownii*, both with fine red flowers, occasionally find their way from the hills to the plain, increasing the variety agreeably in company with the much smaller *Pimeleas*, dressed in a profusion of white or yellow. Larger shrubs are *Acacia Oswaldi*, with rigid dense foliage, semi-arborescent, and *Geijera parviflora*, many stemmed, with dense light green foliage, steeped from September to

but the latter only in company of mallee wherever it approaches the shore. This is the largest of its kind here, mostly forming arborescent shrubs, eminently social, and covering considerable tracts almost exclusively, but also growing into trees some ten or fifteen feet high. It likewise flourishes on the Muloowurtie Hills (Ardrossan marble). Upon it *Loranthus Melaleucæ* is found parasitically; at the last mentioned locality profusely; near Ardrossan seldom. On dry watercourses the graceful *Eremophila longifolia* is sometimes met with. It is a tree about ten or twelve feet high, with pendent branches and large yellowish red flowers in great number; also groups of *Scævola spinescens* and *Lycium australe* occur; the former often infested with hairy galls, looking like tufts of white wool. The mallee-scrub—here principally formed of only two species, *Eucalyptus oleosa* and *E. gracilis;* while another, *E. uncinata*, is more local—covers the greater part of the interior, sometimes extending to the very edge of the shore cliffs, either for some distance or only lining the banks of watercourses. In its company is then found the fine ornamental shrub, *Alyxia buxifolia*, with dark green glabrous leaves (whitish yellow when young), white spiral flowers, and bright red berries. The latter are very attractive for the eye, but obnoxious to the taste. This shrub sometimes forms close thickets, even on the incline of the shore. The native peach, *Santalum acuminatum*, and the popularly termed "poison tree," *Pittosporum phillyræoides*, are plentiful. The profuse red or orange coloured berries of the latter are bitter, but not poisonous; thus the popular name is a misnomer.

A remarkable plant is *Exocarpus aphylla*, which seems to represent savage obduracy as a shrub, with inextricably intertwined stems and branches, no leaves, thickly-set thousands of minute flowerets, and abominably bitter red berries; and as a stunted tree, appears to picture, with its pendent, stiff, dead-looking branches, the hopeless despair of one lost in these dreary thickets. At the foot and along the face of the cliffs, wherever offering a hold, *Atriplex cinereus*, *Nitraria Schoberi*, and *Tetragonia implexicome*, with other salsolaceous plants, *Myoporum insulare* and *Aster axillaris* flourish. The last is a tall shrub and forms large thickets, with *Bursaria spinosa* in sandy beaches, beyond the reach of high water, occasionally interspersed with *Casuarina quadrivalvis*, and (but rarely) *Frenela verrucosa*, which latter prefers higher sandy or rocky soil generally. Wherever the scanty surface-waters of the land find exit at the foot of the cliffs under the sea sand, *Scirpus nodosus* indicates its existence, while the drier dunes are fixed by the rami-

fying stems and roots of *Spinifex hirsutus* an
maritima.

Receding from the shore and ascending the hills
of the plant world gradually changes. One of the mo
of shrubs is *Boronia clavellifolia*, with its hundreds o
pink flowers—blooming for many weeks; it would gr
garden. Other plants deserving the attention of ho
turists are *Halgania lavandulacea* (white), *Prostanthera coccinea* (var
(blue); *Westringia rigida* (white), *Eriostemon lep*
from light yellow through grass green into dark bluish gree
Baeckia crassifolia (white), *Cheiranthera linearis* (beautiful
blue with yellow stamens, about one inch, and easily cultivated)
Lasiopetalum discolor (pink), *Callistemon coccineus* (growing in
and around claypans, and requiring stiff clay with fragments
of granite, the flower cluster is two to three inches long, and of
bright crimson), *Aster pannosus*, and others too numerous to
mention here. As climbers may be recommended the silvery
Billardiera cymosa, var. *sericophora*, with rather large
whitish flowers, the almost leafless *Comesperma volubile*, with
large clusters of sky-blue or purple flowers, and the chast
Clematis microphylla, the latter very easy to grow.

Everywhere the tops of the mallees are interwoven wi
plant with cord-like stems and branches, very minute le
small white flowers and greenish globular berries, ren
some parts almost impenetrable. This is *Cassytha r*
Another smaller species, *C. pubescens*, also epiphyte
preceding, with truncated elliptical berries, prefe
shrubs. A third species, *C. glabella*, with a stem ha
than a thread, but yet several feet long, infes
Cladium and *Xerotes* preferentially, but fastens
thing in its way. It is chiefly found on the
other open tracts.

Some plants appear characteristic of c
Thus *Hibbertia stricta*, *Pomaderris obco*
discolor, and the lowly *Melaleuca parvifloi*
the tertiaries; the delicate *Calycothr*
most profusely where these join the
conglomerates, while the latter are
hexandra, a small, dense, light gree
has been almost invariably obs
quartzites elsewhere; here t
"Native Hop") remains true to
appears on the very silicious
dwarf form, with broader
uncinata was ever noticed
Scrub at Monarto. Its a
the existence of granite

settlers call it "broom," and we use it for covering sheds, &c. *Exocarpus spartea*, among others, is also found in the primary regions chiefly.

There are some plants very remarkable for their variability. Foremost among them is *Eutaxia empetrifolia*. The typical form is a low shrub, with very small pointed leaves, not very closely set, the branchlets almost at right angles; its yellow flowers have numerous dark streaks. The whole shrub seldom exceeds twelve inches in height; the stem is rarely thicker than a goosequill, and is found on all formations. Near the Parara Mine, on ferruginous micaceous schist, it appears in a totally different form, entirely prostrate, and closely pressed to the ground. The longer, narrower leaves are densely crowded along the numerous short branchlets, the flowers much more numerous and larger, and the whole plant presenting quite a different aspect. Along the Maitland road, on granitic or quartzitic soil, it assumes a much larger form, attaining from two to three feet in height. The branchlets are not numerous, very supple and thin; the leaves soft, and about a quarter to half an inch long; the flowers of a pale yellow. It frequently grows side by side with the first mentioned form, thereby forcibly exhibiting the great contrast between them. To this large form the name *Sclerothamnus diffusus* had been given, but it has been reduced to the rank of a variety, on account, as Baron F. v. Mueller says, of numerous insensible gradations from one into the other having been discovered at different localities. *Wahlenbergia gracilis*, the "native bluebell," varies in size from two inches high and a minute floweret (var. *quadrifida*) to fifteen or sixteen inches in height, and a usually blue flower of more than an inch in diameter. A large white flowering variety occurs here. Besides the difference in the flower, the form of the leaves also varies greatly.

Vittadinia australis, common everywhere on open ground, presents at least four well-marked varieties in flower and leaf. The leaves of the typical *Billardiera cymosa* are smooth and dark green, whereas those of the variety *sericophora* are densely covered with white hairs on both sides.

Of other notable forms either in flowers or leaf, the most conspicuous are *Comesperma volubilis*, *Prostanthera coccinea*, and *Eremophila Brownii*. Of variable Orchids may be mentioned *Caladenia pulcherrima*, of which *C. Patersoni*, R. Br., is one variety, but three others occur, different in colour and form. *Caladenia deformis* varies in colour from blue to pink.

Only one new species has as yet been discovered by me, viz., a small Orchid, in respect of which Baron F. v. Mueller, has

small ; the tubers large, globular. It grows under clumps of mallee, and appears common to the tertiary and primary clays. It is rare, and blooms in April.

Plagianthus Berthæ has hitherto only been found between King George's Sound and the Australian Bight, and there it is rare, as Baron F. v. Mueller informed me. It occurs about four miles west of Ardrossan on the south side of the Maitland road for a distance of about two miles pretty plentifully, in company of *Eriostemon lepidotus* and *Halgania lavandulacea*. *Helipterum heteranthum* had also hitherto been known from W. Australia only; it is a small plant and of rare occurrence. *Thysanotus exasperatus* and *Pterostylis barbata* were only known from one spot each in South Australia, the former from the Flinders Range, the latter from near Mount Lofty; both grow here in the scrub, near Yorke Valley, but scantily. *Swainsona laxa*, R. Br., on the contrary, is an example of a plant hitherto not known to occur so far westward. It is a pretty plant, and has only been seen in the limestone gorge formed by Rogue's Gully in the Muloowurtie hills. Other plants, the localities of which are mentioned as new by Baron F. v. Mueller, are *Dodonæa hexandra*, *Melaleuca acuminata*, *Goodenia albiflora*, at Kalkabury; *Hibiscus Wrayæ*, at Kilkerran; *Daviesia genistifolia*, low ground on the Maitland road; *Hydrocotyle capillaris*, *Didiscus cyanopetalus*, *Minuria suædifolia* (the last three small herbs), and *Poa lepida*, a small but pretty grass and rather rare. *Tompletonia sulcata* is, besides, remarkable for its leafless, flattened, brittle, light green branches. It occurs only on rich clay soil.

Of naturalised weeds 33 are enumerated as observed and collected. Some of them are happily of rare occurrence as yet; for example, *Xanthium spinosum*, the Bathurst burr, and the common Scotch thistle, *Onopordon Acanthium*. Others form good food for cattle, as *Medicago denticulata* (wild clover), and *Polygonum aviculare*. In respect of a few I feel inclined to consider them rather as cosmopolitan vagrants than as introduced forms, having known them 30 years ago as plentiful as now among the true native flora. That they have become more conspicuous I think is greatly owing to the suppression of many native forms through the browsing of cattle, the hardier plants taking the place of the more delicate. The following are adverted to, viz., *Sonchus oleraceus*, *S. asper*, *Hypochoeris glabra*, and *Geranium cicutarium* among herbs; and *Festuca bromoides*, the silver grass, among Graminese. *Orobanche cernua* I have only met once, growing by the side of the road, Kilkerran, on decaying vegetable debris and sandy soil. It is a small plant

In conclusion it must be stated that the geological distribution of the plants has been described as hitherto observed. Future observations may disclose reasons to alter the arrangement in some instances. In this case and after accumulation of further material, I shall feel happy in laying the results before the Society.

NATIVE AND NATURALISED PLANTS,

ARDROSSAN, YORKE'S PENINSULA.

Collected by OTTO TEPPER, F.L.S., Corr. Member. Named and arrangement revised by BARON F. von MUELLER, K.C.M.G., F.R.S., &c., Hon. Member.

[Read April 6, 1880.]

I.—NATIVE PLANTS.

DICOTYLEDONS.

RANUNCULACEÆ.

Clematis microphylla, *De Candolle*. G.
Ranunculus parviflorus, *Linné*. P.

DILLENIACEÆ.

Hibbertia stricta, *R. Brown*. T.

PAPAVERACEÆ.

Papaver aculeatum, *Thunberg*. Maitland road. P.

CRUCIFERÆ.

Alyssum linifolium, *Stephen*. Coast.
Erysimum brevipes, *F. M.* Coast.
lasiocarpum, *F. M.* G.
Stenopetalum lineare, *R. Brown*. Coast.
sphærocarpum, *F. M.* Coast.
Capsella elliptica, *Meyer*. Coast.
pilosula, *F. M.* Coast.
Lepidium monoplocoides, *F. M.* G.

PITTOSPOREÆ.

Pittosporum phillyræoides, *De Candolle*. G.
Bursaria spinosa, *Cavanilles*. G.

var. sericophora, *F. M.* Coast. T.
Cheiranthera linearis, *A. Cunningham.* T.

DROSERACEÆ.

Drosera glanduligera, *Lehmann.* T.
Menziesii, *R. Brown.* Coast and T.
Whittakeri, *Planchon.* Kalkabury. P.

POLYGALEÆ.

Comesperma volubile, *Labilladiere.* G.

FRANKENIACEÆ.

Frankenia lævis, *Linné.* Swamps. C.

PHYTOLACCEÆ.

Didymotheca thesioides, *J. Hooker.* Kilkerran. T

CARYOPHYLLÆ.

Saponaria tubulosa, *F. M.* Coast plain.
Sagina apetala, *Arduino.* P.
Spergularia rubra, *Persoon.* Coast, plain.
var. marginata. Kilkerran, west coast.

PORTULACEÆ.

Claytonia calyptrata, *F. M.* G
corrigiolacea, *F. M.* Coast.

FICOIDEÆ.

Mesembrianthemum æquilaterale, *Haworth.* T. and P.
australe, *Solander.* G.
Tetragonia implexicoma, *J. Hooker.* Coast.

SALSOLACEÆ.

Rhagodia Billardieri, *R. Brown.* Coast and T.
nutans, *R. Brown.* G.
spinescens, *R. Brown.*
var. deltophylla.
parabolica, *R. Brown.*
Chenopodium nitrariaceum, *F. M.* Coast.
microphyllum, *F. M* P.
carinatum, *R. Brown.* Swamp, Mangrove Point.
Atriplex paludosum, *R. Brown.* Swamp, Mangrove Point.
cinereum, *Poiret.* Coast.
prostratum, *R. Brown.* Ardrossan. Coast.
Enchylæna tomentosa, *R. Brown.* Coast.
Kochia villosa, *Lindley.* Coast.
Salsola Kali, *Linné.*
oppositifolia, *F. M.* Swamp, Mangrove Point.
brevifolia, *R. Brown.* Coast.

Salicornia australis, *Forster*. Kilkerran, West Coast.
arbuscula, *R. Brown*. Kilkerran, West Coast.

AMARANTACEÆ.

Ptilotus spathulatus, *Poiret*. Open ground, G.

POLYGONACEÆ.

Rumex Brownii, *Campdera*. Open ground, G.
Muehlenbeckia adpressa, *Meissner*. P.

MALVACEÆ.

Lavatera plebeia, *Sims*. Coast and T.
Plagianthus Berthæ, *F. M.* Maitland road, P.
spicatus, *Bentham*. Muloowurtie, P., burnt soil.
Sida corrugata, *Lindley*. P.
Hibiscus Wrayæ, *Lindley*. Kilkerran, P.

STERCULIACEÆ.

Lasiopetalum discolor, *Hooker*. T.
Behrii, *F. M.* T. and P.
Baueri, *Steetz*. P.

LINEÆ.

Linum marginale, *A. Cunningham*. G.

ZYGOPHYLLEÆ.

Nitraria Schoberi, *Linné*. Coast.
Zygophyllum fruticulosum, *De Candolle*. Coast.
Billardieri, *De Candolle*. Parara Mine, P.
ammophilum, *F. M.* Coast.
glaucescens, *F. M.* Muloowurtie and Ardros. C.
crenatum, *F. M.* Coast and T.

GERANIACEÆ.

Geranium dissectum, *Linné*. G.
Erodium cygnorum, *Nees*. G.
Pelargonium australe, *Willdenow*. G.
var. erodioides, *Hooker*. G.
Oxalis corniculata, *Linné*. G.

RUTACEÆ.

Boronia clavellifolia, *F. M.* G.
Eriostemon lepidotus, *Sprengel*. Maitland road, P.
var. sediflora.
capitatus, *F. M.* Maitland road.
Correa speciosa, *Aiton*. G.
Geijera parviflora, *Lindley*. Coast.

bursariifolia, *Behr* and *Mueller*. T and P.
Baueri, *Endlicher*. P.
hexandra, *F. M.* T.
boroniæfolia, *G. Don*. Yorke Valley, P.
humilis, *Endlicher*. Maitland road, P.
stenozyga, *F. M.* Parara Mine, P.
Heterodendron oleæfolium, *Desfont.* Ardrossan, coast.

STACKHOUSIÆ.

Stackhousia linarifolia, *Cunningham*. Coast and T.

URTICEÆ.

Parietaria debilis, *Forster*. Coast and T.

EUPHORBIACEÆ

Euphorbia Drummondi, *Boissier*. Open low ground, G.
Poranthera microphylla, *Brongniart*. Burnt ground, G.
Beyeria opaca, *F. M.* Coast and T.
Adriana quadripartita, *Gaudichaud*. Yorke Valley, P.

RHAMNACEÆ.

Pomaderris obcordata, *Fenzl*. T.
racemosa, *Hooker*. G.
Spyridium leucophractum, *F. M.* T. and P.
eriocephalum, *Fenzl*. T. and P.
Cryptandra amara, *Smith*. T.
tomentosa, *Lindley*. T.

LEGUMINOSÆ.

Daviesia genistifolia, *A. Cunn.* Maitland rd., lowest ground, P.
Pultenæa tenuifolia, *R. Brown*. Yorke Valley, P.
Eutaxia empetrifolia, *Schlechtendal*. G.
var. diffusa. Yorke Valley, P.
Templetonia sulcata, *Bentham*. Maitland road, P.
Swainsona phacoides, *Bentham*. Coast.
laxa, *R. Brown*. Rogue's Gully, Muloowurtie, P.
Glycine clandestina, *Wendland*. G.
Kennedya prostrata, *R. Brown*. Coast and T.
var. albiflora. Maitland, P.
monophylla, *Ventenat*. T. and P.
Lotus australis, *Seringe*. Coast.
var., Behriana. P hills.
Indigofera australis, *Willd.* Rogue's Gully, Muloowurtie, P.
Cassia eremophila, *A. Cunningham*. T. and P.
heteroloba, *Lindley*. T.

Acacia spinescens, *Bentham*. T. and P.
hakeoides, *Cunningham*. Ardrossan. C. and T.
rigens, *A. Cunningham*. Maitland-road, P.
sclerophylla, *Lindley*. G.
Osswaldi, *F. M.* Coast.
notabilis, *F. M.* Yorke Valley, P.
salicina, *Lindley*. G.
longifolia, *Willdenow*. T. and P.
var. Sophoræ, *R. Brown*.
brachybotrya, *Bentham*. Ardrossan, P.
microcarpa, *F. M.* Yorke Valley, swamp.

ROSACEÆ.

Acæna ovina, *A. Cunningham*. Coast.

CRASSULACEÆ.

Tillæa macrantha, *J. Hooker*. Open ground, G.
purpurascens, *J. Hooker*. Open ground, G.
verticillaris, *De Candolle*. Kalkabury, P.

HALORAGEÆ.

Haloragis tetragyna, *R. Brown*. Yorke Valley, P.
ceratophylla, *Endlicher*. Maitland road, P.

LAURINEÆ.

Cassytha melantha, *R. Brown*. G.
pubescens, *R. Brown*. G.
glabella, *R. Brown*. G.

MYRTACEÆ.

Calycothrix tetragona, *Labillardiere*. T.
Bæckia crassifolia, *Lindley*. T. and P.
Callistemon coccineus, *F. M.* Yorke Valley, P.
Melaleuca acuminata, *F. M.* G.
parviflora, *Lindley*. T.
uncinata, *R. Brown*. P.
ericifolia, *Smith*. Coast.
var. pustulata, *J. Hooker*.
Eucalyptus gracilis, *F. M.* G.
uncinata, *Turczaninow*. P.
oleosa, *F. M.* G.
odorata, *Behr*. P.
incrassata, *Labill*. Yorke Valley, clay-pans.

UMBELLIFERÆ.

Hydrocotyle callicarpa, *Bunge*. P., sandy ridge.
capillaris, *F. M.* P., " "
Didiscus eriocarpus, *F. M.* P., " "
cyanopetalus, *F. M.* P., " "

Vittadinia australis, *A. Richard* (four varieties). G.
Minuria leptophylla, *De Candolle*. G.
Cunninghami, *Bentham*. Coast.
suædifolia, *F. M.* Kilkerran, sea-beach.
Calotis hispidula, *F. M.* Coast.
lappulacea, *Benthan*. Coast.
Lagenophora Billardieri, *Cassini*. P.
var. Huegeli.
Brachycome pachyptera, *Turcz*. Coast.
ciliaris, *Lessing*. Coast, T.
collina, *Bentham*. T. and P.
tenella, *Turczaninow*. Coast.
Elachanthus pusillus, *F. M.* Coast.
Myriocephalus rhizocephalus, *Bentham*. Kalkabury.
Calocephalus citreus, *Lessing*. Coast.
Brownii, *F. M.* Kilkerran, western coast.
Angianthus strictus, *Bentham*. T. and P.
tomentosus, *Wendland*. Coast.
Isoetopsis graminifolia, *Turcz*. Coast.
Gnephosis skirrophora, *Bentham*. Burnt ground, G.
Gnaphalodes uliginosum, *A. Gray*. G.
Craspedia Richea, *Cassini*. Coast and T.
Cassinia lævis, *R. Brown*. T. and P.
arcuata, *R. Brown*. Ardrossan, T. and C.
aculeata, *R. Brown*. Muloowurtie, coast.
Humea cassiniacea, *F. M.* Maitland road, P.
Toxanthus perpusillus, *Turcz*. G.
Rutidosis Pumilo, *Bentham*. Coast.
Millotia tenuifolia, *Cassini*. G.
Athrixia tenella, *Bentham*. Coast.
Podotheca angustifolia, *Cassini*. Coast and roadsides, G.
Podolepis acuminata, *R. Brown*. Coast and T.
canescens, *A. Cunningham*. T. and P.
rugata, *Labillardiere*. P.
Lessoni, *Bentham*. Coast.
Leptorrhynchus pulchellus, *F. M.* G. open ground.
squamatus, *Lessing*. Coast and T.
medius, *Cunningham*. P.
elongatus, *De Candolle*. T. and P.
Waitzia, *Sonder*. P.
Helichrysum Baxteri, *A. Cunningham*. P.
lucidum, *Haeckel*. Maitland road. P.
leucopsidium, *De Candolle*. G.
retusum, *F. M.* T. and P.
apiculatum, *De Candolle*. G.

var. Stuartiana, *Sonder* and *Mueller*.
hyalsopermum, *F. M.* Coast.
corymbiflorum, *Schlechtendal.* T. and P.
pygmæum, *F. M.* Coast.
exiguum, *F. M.* Coast.
dimorpholepis, *Bentham.* T. and P. (hills.)
heteranthum, *Turcz.* Coast.
Gnaphalium Japonicum, *Thumberg.* G. on open ground.
indutum, *Hooker.* G. on open ground.
Stuartiana Muelleri, *Sonder.* P. burnt ground.
Erechthites quadridentata, *De Candolle.* G.
hispidula, *De Candolle.* Yorke Valley, swamp.
picridioides, *Turcz.* Coast and T.
Senecio lautus, *Forster.* Coast.
brachyglossus, *F. M.* G.
Cunninghami, *De Cand.* Coast.
Cymbonotus Lawsonianus, *Gaudichaud.* Coast and P. (G.)
Microseris Forsteri, *J. Hooker.* Coast.

STYLIDIEÆ.

Leeuwenhœkia dubia, *Sonder.* Coast.

GOODENOVIEÆ.

Velleia paradoxa, *R. Brown.* G. open ground.
Goodenia ovata, *Smith.* T. and P.
geniculata, *R. Brown.* G.
albiflora, *Schlechtendal*, Kalkabury. P.
cycloptera, *R. Brown.* Coast.
pinnatifida, *Schlechtendal.* Coast and P.
Scævola spinescens, *R. Brown.* G.
crassifolia, *Labill.* Kilkerran and Muloowurtie, coast.
Dampiera rosmarinifolia, *Schlechtendal.* G.

CAMPANULACEÆ.

Wahlenbergia gracilis, *A. De Candolle.* G.
var. quadrifida. Maitland road, P.
Lobelia microsperma, *F. M.* Ardrossan, G.

EPACRIDEÆ.

Styphelia ovalifolia, *R. Brown.* T.
cordifolia, *F. M.* P.
humifusa, *Labillardiere.* T. and P.
patula, *R. Brown.* Coast and T.

PRIMULACEÆ.

Samolus repens, *Persoon.* Salt Marsh, Mangrove Point.

LOGANIACEÆ.

Logania ovata, *R. Brown*. P.
linifolia, *Schlechtendal*. P.

GENTIANEÆ.

Sebæa ovata, *R. Brown*. Coast.
Erythræa australis, *R. Brown*. G.

PLANTAGINEÆ.

Plantago varia, *R. Brown*. G.

BORAGINEÆ.

Halgania lavandulacea, *Endlicher*. Maitland road, P.
cyanea, *Lindley*. Yorke Valley, P.
Myosotis australis, *R. Brown*. Yorke Valley, T. and P.
Cynoglossum suaveolens, *R. Brown*. Yorke Valley, T. and P.
Eritrichium australasicum, *A. De Candolle*. Coast.
Echinospermum concavum, *F. M.* Coast.

CONVOLVULACEÆ.

Convulvulus erubescens, *Sims*. Coast and T.
Wilsonia rotundifolia, *Hooker*. Yorke Valley, swamp.

SOLANACEÆ.

Lycium australe, *F. M.* Coast.
Solanum simile, *F. M.* T. and P.
fasciculatum, *F. M.* T. and coast; burnt ground
Nicotiana suaveolens, *Lehmann*. Coast and P. (G.)

SCROPHULARINÆ.

Veronica calycina, *R. Brown*. Yorke Valley, P.
Euphrasia Brownii, *F. M.* P.

MYOPORINÆ.

Myoporum parvifolium, *R. Brown*. Coast.
deserti, *A. Cunningham*. Maitland road, P.
viscosum, *R. Brown* P.
insulare, *R. Brown*. Coast,
platycarpum, *R. Brown*. P.
Eremophila longifolia, *F. M.* Coast.
Brownii, *F. M.* Coast and T.
" *var.* tomentosa. Kalkabury, P.
Behriana, *F. M.*

VERBENACEÆ.

Avicennia officinalis, *Linné*. Swamp, Mangrove Point.

LABIATÆ.

Mentha saturejoides, *R. Brown*. Yorke Valley, T. and P.
Prostanthera coccinea, *F. M.* T. and P.
Westringia rigida, *R. Brown*. G.
Teucrium sessiliflorum, *Bentham*. Coast and T.
racemosum, *R. Brown*. P.

CASUARINEÆ.

Casuarina distyla, *Ventenat*. P.
quadrivalvis, *Labillard*. Coast and P. (G.)

CONIFERÆ.

Frenela verrucosa, *Mirbel*. T. and P.

MONOCOTYLEDONS.

HYDROCHARIDEÆ.

Halophila ovalis, *Gaudichaud*. C. submarine.

ORCHIDEÆ.

Thelymitra longifolia, *Forster*. G.
antennifera, *J. Hooker*. P.
Diuris palustris, *Lindley*. Coast and T.
pedunculata, *R. Brown*. Coast and T.
Prasophyllum patens, *R. Brown*. G.
Tepperi, *F. M. (spec. nov.)*. T. and P.
Microtis porrifolia, *R. Brown*. Coast and T.
Pterostylis reflexa, *R. Brown*. T.
barbata, *Lindley*. Yorke Valley, P.
mutica, *R. Brown*. T.
longifolia, *R. Brown*. Coast and T.
rufa, *R. Brown*.
var. Mitchelli, *Lindley*. G., open g.
Eriochilus autumnalis, *R. Brown*.
Cyrtostylis reniformis, *R. Brown*. Yorke Valley, P.
Caladenia Patersoni, *R. Brown*. G., open ground.
latifolia, *R. Brown*. Yorke Valley, P.
deformis, *R. Brown*. Coast and T.
Glossodia major, *R. Brown*. P.

AMARYLLIDEÆ.

Hypoxis glabella, *R. Brown*. G. open ground.
Calostemma purpureum, *R. Brown*.

LILIACEÆ.

Thysanotus Patersoni, *R. Brown* Coast and T.
exasperatus, *F. M.* Yorke Valley, P.
Arthropodium minus, *R. Brown*. G.
strictum, *R. Brown*. Coast.

Wurmbsea diotia, *F. M.* G.
Burchardia umbellata, *R. Brown.*
Dianella revoluta, *R. Brown.* G.

Xerotideæ.

Xerotes glauca, *R. Brown.* G.
leucocephala, *R. Brown.* Tiddy Widdy, coast.
effusa, *Lindley.* Coast and T.
dura, *F. M.* Coast.

Juncaceæ

Juncus pallidus, *R. Brown.* Yorke Valley.
bufonius, *Linné.* Yorke Valley.

Najadeæ.

Triglochin centrocarpa, *Hooker.* Coast.
Cymodocea antarctica, *Endlicher.* C. submarine.
Zostera nana, *Mertens.* C. submarine.
Posidona australis, *J. Hooker.* C. submarine

Cyperaceæ.

Scirpus cartilagineus, *Sprengel.* G., prefers burnt ground.
nodosus, *Rottboell.* Sand dunes, coast.
Cladium lanigerum, *R. Brown.* G.
deustum, *R. Brown.* Coast, Muloowurtie, and P.
Lepidosperma gladiatum, *Labillardiere.* Kilkerran, coast
Chorisandra enodis, *Nees.* Yorke Valley, swamp.

Gramineæ.

Spinifex hirsutus, *Labillardiere.* Coast, sandy beach.
Anthisteria ciliata, *Linné.* T. and P.
Aristida Behriana, *F. M.* Yorke Valley.
Stipa semibarbata, *R. Brown.* T. and P., burnt ground.
elegantissima, *Labillardiere.* Coast and T.
scabra, *Lindley.* G.
crinita, *Gaudichaud.* G.
aristiglumis, *F. M.* Coast and T.
Dichelachne crinita, *J. Hooker.* T.
Agrostis Solandri, *F. M.* G.
Danthonia penicillata, *F. M.* G.
Poa cæspitosa, *Forster.* G.
lepida, *F. M.* Coast.
Festuca irritans, *F. M.* (Porcupine grass). Kilkerran, T.
Agropyrum scabrum, *Beauvois.* G.
Distichlis maritima, *Rafinesque.* Coast, beach.
Bromus arenarius, *Labillardiere.* G.

Amphipogon strictus, *R. Brown.* Coast and T.
Lepturus incurvatus, *Trinius.* G.

ACOTYLEDONS.

Filices.

Ophioglossum vulgatum, *Linné.* Coast.
Cheilanthes tennifolia, *Swartz.* G.
Grammitis rutifolia, *R. Brown.* P.

II.—NATURALISED PLANTS.

Capsella bursa-pastoris, *Moench.* Cruciferæ.
Lepidium ruderale, *Linné.* "
Senebiera didyma, *Persoon.* "
Silene gallica, *Linné.* Caryophylleæ.
Cerastium vulgatum, *Linné.* "
Stellaria media, *Villars.* "
Polygonum aviculare, *Linné.* Polygonaceæ.
Malva rotundifolia, *Linné.* Malvaceæ.
Erodium cicutarium, *L'Heretier.* Geraniaecæ.
Medicago denticulata, Leguminosæ.
Melilotus parviflora, *Des.* "
Urtica urens, *L.* Urticeæ.
Cucumis myriocarpa, *Naudin.* Cucurbitaceæ.
Erigeron linifolius, *Willdenow.* Compositæ.
Anthemis Cotula, *Linné.* "
Gnaphalium luteo-album, *Linné.* "
Hypochœris glabra, *Linné.* "
Picris hieracioides, *Linné.* "
Sonchus oleraceus, *Linné.* "
var, asper, *Linné.* "
Centaurea melitensis, *L.* "
Silybum Marianum, *Gaertner.* "
Xanthium spinosum, *L.* "
Cryptostemma calandulaceum, *R. Brown.* Compositæ.
Anagallis arvensis, *var.* cœrula, *L.* Primulaceæ.
Plantago coronopus, *L.* Plantagineæ.
Lithospermum arvense, *L.* Borragineæ.
Solanum nigrum, *L.* Solanaceæ.
Orobanche cernua, *Loeffling.* Orobanchaceæ.
Chenopodium murale, *L.* Salsolaceæ.
Poa annua, *L.* Gramineæ.
rigida, *L.* "
Festuca bromoides, *L.* "
Kœleria phleoides, *Persoon.* "
Hordeum murinum, *L.* "

A CENSUS OF THE

INDIGENOUS FLOWERING PLANTS AND FERNS

OF EXTRA-TROPICAL SOUTH AUSTRALIA.

By Professor Ralph Tate, Assoc. Lin. Soc., F.G.S., &c., President.

[Read February 3, 1880.]

Introductory and Explanatory Remarks.—In 1875 there appeared Dr. Schomburgk's "Flora of South Australia," in which is included a catalogue of the flowering plants and ferns of South Australia, mostly compiled from the "Flora Australiensis," vols. 1 to 6. Since then vol. 7 of that work has been published, and numerous additions to the flora of this province have been made by Messrs. Giles, Tietkins, Young, Tepper, Kempe, Mrs. Richards, and others. These accessions, as well as the necessary corrections to Dr. Schomburgk's list, render a revised census much to be desired. Despite the imperfections of my list, yet I believe it will be exceedingly useful as furnishing a good basis for further additions. It is one to be improved upon, and some years hence, when the inland vegetation will have become exhaustively known and the geographical range of the larger number of our indigenous plants better defined, a new edition will be required.

The present census is compiled from the "Flora Australiensis" by Mr. Bentham, and from the "Fragmenta Phytographiæ" and other works, by Baron F. von Mueller, and from manuscript notes kindly communicated by the latter gentleman. It contains the names of all indigenous flowering plants and ferns and their immediate allies authentically known to occur in the extra-tropical part of this colony. The undoubted alien species are omitted, and may at some future time form a supplementary list to be published under the auspices of this Society.

The list has been revised by Baron F. von Mueller, and the ordinal arrangement and nomenclature are for the most part in accord with that gentleman's matured researches. As the sequence of the orders is materially different from that followed

particular order of plants. After following the name of the species is a reference to the page of the "Flora Australiensis" on which its diagnosis will be found. The references to species not contained in the "Flora Australiensis" are to Baron Mueller's "Fragmenta Phytographiæ," thus:—*Menkea sphærocarpa*, F.M.; Frag. VIII., 223, is described on page 223 of volume VIII. of that work, the authority for the name being Ferdinand Mueller.

To give some idea of the distribution of the constituents of the flora of extra-tropical South Australia, that part of the province is divided into the following regions and districts:—

Region C, or the Central Australian Region, which embraces the country north of a line from the Head of the Great Australian Bight following eastward the line referred to in the 11th Schedule of Crown Lands Act of 1877, extending southward so as to include Lake Gilles, and sweeping round the east side of Lake Torrens, thence to the west side of Lake Frome, and southward to the latitude of Menindie (about 32 degrees).

This region probably admits of division into (*a*) Desert and (*b*) Central Australian; the latter division embracing the elevated country of the Musgrave, MacDonnell's and other ranges, which extend in a general east and west direction in the north-west central parts of the colony. Constituting a part of the same region, by its geological and botanical features, is the narrow strip of hill country traversed by the transcontinental telegraph line between the head of Lake Torrens and the Tropic of Capricorn.

By such division the desert region embraces the vast Tertiary plains and deserts; whilst the Central Australian region is comprised of more elevated land of Palæozoic age.

Though the Central Australian subregion verges on the tropics, yet its flora is of the Desert type, somewhat modified by the presence of a few families and genera which herein reach their southern limits.

Region C is characterised by the large proportion of Crucifers, Zygophylleæ, Malvaceæ, Sterculiaceæ, Euphorbiaceæ, Amarantaceæ, Chenopodiaceæ, Portulaceæ, Ficoideæ, Goodenovieæ, Solanaceæ, Verbenaceæ, Myoporineæ, and Grasses. The only representatives in South Australia proper of Capparids, Elatineæ, Cycads, and Palms are here met with. The following important orders, so characteristic of Region S, or the South Australian region, are either absent or poorly represented:—Pittosporeæ, Droseraceæ, Caryophyllaceæ, Rhamnaceæ, Epacrideæ, Orchidaceæ, Liliaceæ, and Juncaceæ.

Region M, or the Murray Desert.—This region is the southerly extension of the eastern section of the Central Australian Region. It may be defined as the whole of the country (exclusive of Region E) to the east of the Adelaide chain, and its N.E. extension towards the Barrier Ranges. Its physical features are very pronounced, for whilst the region to the west is occupied by elevated ground of Palæozoic age, the Murray Desert is a plain constituted of Tertiary rocks. Like that of the Central Australian Region, the rainfall is absolutely small.

The geophilous florula of this region, excepting the exclusively maritime species, is of the same type as that of Region C, though it possesses fewer restricted species. The fluviatile and paludinal species of the River Murray, which receives little or no drainage in its passage through this region, assimilate the vegetation of the Murray Region to that of Region S *c*.

Region E, or that of the South-East, being the extreme south-east corner of this colony, centred about the volcanic area of Mount Gambier. To the Rev. J. E. Tenison Woods, F.L.S., &c., my obligations are due for the use of a MS. list of plants observed by him in the South-East district of this colony between the years 1857 and 1867. It contains the names of over 200 species hitherto unrecorded for that part of South Australia. Baron F. von Mueller is the authority for nearly all of them. Its vegetation has the general characteristic of that of Region S *c*, and is mainly distinguished from it by the possession of species which here reach their western limit. The sole representative in South Australia of the order Caprifoliaceæ occurs in this region. The northern boundary line of the region must be somewhat south of the railroad connecting Kingston and Narracoorte.

Region S, or the South Australian Region, embraces the rest of the province. It may be divided into the following districts:—

a. The country to the north of the head of St. Vincent's Gulf.
b. Eyre's Peninsula, and westward to the head of the Great Australian Bight, south of the south-western boundary of Region C.
c. The country south of District *a*, east of St. Vincent's Gulf, and on the east limited by the Murray Desert.
d. Yorke's Peninsula.
k. Kangaroo Island

The prominent botanical features of Region S have been referred to under Region C.

Note.—The capital and small letters in the columns indicating the distribution of a species are correspondingly those of the regions and districts used in the foregoing paragraphs.

The following table represents the number of species inhabiting each region, and the number of species restricted to each:—

	C	M	E	S	*a*	*b*	*c*	*d*	*k*
Total number of species	688	550	455	959	967	382	643	881	154
Number of restricted species ..	355	81	124	272	25	31	96	9	13
and marked varieties ..	3	3	2	4	—	1	3	2	4

The high percentage of restricted species inhabiting each region seems to justify that botanical division of the province which has herein been established. Nevertheless, the above figures may not represent the whole truth; thus the small number of species catalogued for the Regions M and E includes, perhaps, only the less common forms; and if the real numerical strength of each were known, doubtlessly the total of peculiar species in the adjoining regions might be much reduced, though the number of restricted species in Regions M and E would not be materially altered. The same remarks will also apply to the districts of Region S. It should be remembered that the boundaries of the regions and districts are not rigidly defined, as such can only be laid down after an exhaustive inquiry into the climatological, botanical, and geological features of each division And at the same time, that in a first attempt of the kind, it has not always been easy to find the geographic columns for each species, more particularly because one region must overlap or pass gradually into another.

Dr. Schomburgk's list of extra-tropical plants gives the names of 1,214 species; but the number is reducible to 1,074 by exclusion of certain introduced species and others not known to belong to extra-tropical South Australia, and by suppression of names not of specific value. Some species have wrongly assigned to them a South Australian habitus in the Flora Australiensis, by reason of certain Victorian localities being quoted for this colony. Baron von Mueller has considerably reduced the number of species recognised by Mr. Bentham, but whether the results obtained are in accordance with or opposed to the teachings of the living plants is a question that each botanist must endeavour to answer for himself, as the plan of the present work does not admit of a discussion of the many questions raised by them.

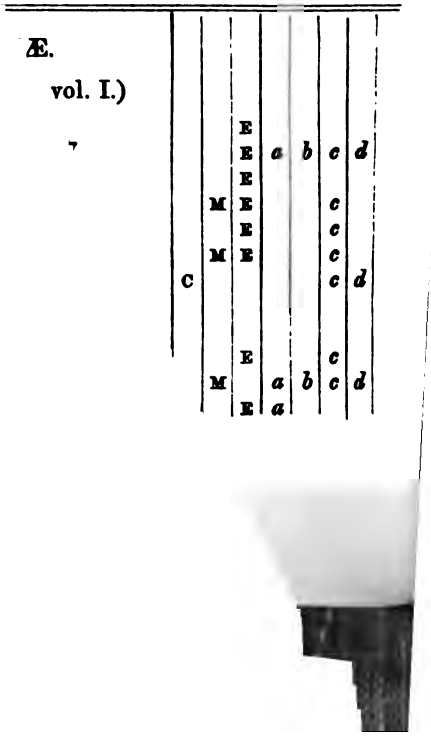
The result of the present compilation, so far as numbers are concerned, is as follows :—

	Orders.	Genera.	Species.
1. Dicotyledoneæ	80	360	1,230
2. Monocotyledoneæ ...	15	112	321
3. Acotyledoneæ	3	18	31
	98	490	1,582

'he most prominent orders by the number of their species -

	No. of Species.	No. of Genera.	Ratio of Species to Genera as 1.
'mpositæ ...	200	53	3·7
'uminosæ ...	165	34	4·8
'ineæ ...	111	40	3·7
'podiaceæ	72	12	6
'ceæ ...	69	11	6·3
'æ ...	65	11	5·9
ubordinate rank—			
' ...	47	17	2·7
æ ...	40	8	5
...	39	2	19·5
..	34	8	4·2
	33	10	3·3
	32	8	4

third column represent in an inverse
e of the natural orders in respect to
Orchidaceæ heading the list and Myo-



fasciculata, *R. Brown*; 33			E	*a*	*b*	*c*		
virgata, *R. Brown*; 34	C	M						
glaberrima, *F. M.*; 39	C							
Laurineæ (Fl. Aust., vol. V.)								
Cassytha glabella, *R. Brown*; 309		M	E		*b*		*d*	*k*
pubescens, *R. Brown*; 310		M	E		*b*	*c*	*d*	
melantha, *R. Brown*; 311	C	M		*a*	*b*	*c*	*d*	
Papaveraceæ (Fl. Aust., vol. I.)								
Papaver aculeatum, *Thunb.*; 63		M		*a*		*c*	*d*	
Cruciferæ (Fl. Aust., vol. I.)								
Nasturtium terrestre, *R. Brown*; 65		M	E			*c*		
Cardamine laciniata, *F. M.*; 69		M	E			*c*	*d*	
hirsuta, *Linné*; 70			E	*a*		*c*		
eustylis, *F. M.*; 71		M						
Alyssum mininum, *Pallas*; 71		M		*a*	*b*		*d*	
Sisymbrium filifolium, *F. M.*; 74				*a*				
trisectum, *F. M.*; 74	C	M		*a*	*b*			
nasturtioides, *F. M.*; 74		M		*a*				
cardaminoides, *F. M.*; 75		M	E			*c*		
Erysimum curvipes, *F. M.*; 75	C	M		*a*			*d*	
brevipes, *F. M.*, 75	C	M		*a*			*d*	
lasiocarpum, *F. M.*; 76	C	M						
Blennodia, *F. M.*; 76	C							
Richardsi, *F. M.*; Frag. x., 105	C							
Stenopetalum velutinum, *F. M.*; 78	C	M						
lineare, *R. Brown*; 78		M			*b*	*c*	*d*	
sphærocarpum, *F. M.*; 78		M		*a*	*b*	*c*	*d*	
nutans, *F. M.*; 79	C							
Menkea sphærocarpa, *F. M.*; Frag. viii., 223	C							
australis, *Lehmann*; 80		M						
Capsella elliptica, *Meyer*; 81		M	E		*b*	*c*	*d*	
pilosula, *F. M.*; 82	C	M					*d*	
humistrata, *F. M.*; Frag. xi., 25		M						
cochlearina, *F. M.*; 88				*a*	*b*			
Drummondi, *F. M.*; 88	C							
Geococcus pusillus, *Drummond*; 80		M			*b*		*d*	
Lepidium strongylophyllum, *F. M.*; 84	C							
leptopetalum, *F. M.*; 84		M						
phlebopetalum, *F. M.*; 85	C	M		*a*				
monoplocoides, *F. M.*; 85		M					*d*	
papillosum, *F. M.*; 86	C	M		*a*				
foliosum, *Desv.*; 86			E					*k*
ruderale, *Linné*; 86	C	M						

l. Aust., vol. I.)
Smith; 96
nné; 90
s (Fl. Aust., vol. I.)
sfolia, Smith; 99
ces, Labill.; 99
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aurantiacus, F. M.; 102
RACEÆ (Fl. Aust., vol. II.)
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duligera, Lehm.; 457
sa, De Cand.; 457
nni, Vahl.; 459
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ri, Labill.; 461
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m.; 127
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l. I.)
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Commersonia magniflora, *F. M.*; Frag. x., 22	c							
loxophylla, *F. M.*; 240	c							
Seringea nephrosperma, *F. M.*; 246	c							
Hookeriana, *Walp.*; 246	c							
integrifolia, *F. M.*; 247	c							
Thomasia petalocalyx, *F. M.*; 255			E			c		*k*
Lasiopetalum discolor, *Hooker*; 260					*b*		*d*	*k*
Behrii, *F. M.*; 261	c	M		*a*	*b*	*c*	*d*	*k*
Baueri, *Stoetz*; 263		M		*a*	*b*	*c*	*d*	*k*
Schulzeni, *F. M.*; 265			E		*b*			*k*
Brachychiton Gregorii, *F. M.*; Frag. iv., 187	c							
MALVACEÆ (Fl. Aust., vol. I.)								
Lavatera plebeia, *Smith*; 185	c	M		*a*	*b*	*c*	*d*	
Malvastrum spicatum, *A. Gray*; 187	c			*a*				
Plagianthus spicatus, *Benth.*; 189		M	E		?		*d*	
glomeratus, *Benth.*; 190	c				*b*		*d*	
microphyllus, *F. M.*; 190		M	E		*b*	*c*		
Berthæ, *F. M.*; Frag. v., 108							*d*	
Sida corrugata, *Lindley*; 192	c	M		*a*	*b*		*d*	
cardiophylla, *F. M.*; Frag. viii., 242	c							
intricata, *F. M.*; 193	c							
virgata, *Hooker*; 194	c							
cryphiopetala, *F. M.*; 194	c							
petrophila, *F. M.*; 194	c			*a*				
calyxhymenia, *Gay*; 194	c							
inclusa, *Bentham*; 197	c							
Howittia trilocularis, *F. M.*; 198	c	M						
Abutilon tubulosum, *A. Cunn.*; 200	c							
leucopetalum, *F. M.*; 200	c							
Mitchelli, *Benth.*; 201				*a*				
macrum, *F. M.*; Frag. ix., 59	c							
otocarpum, *F. M.*; 202	c	M						
Avicennæ, *Gaertn.*; 203	c	M						
Fraseri, *Hooker*; 205				*a*				
diplotrichum, *F. M.*; 205	c							
Hibiscus trionum, *Linné*; 210	c							
brachysiphonius, *F. M.*; 210	c							
microchlænus, *F. M.*; 211	c							
Pinonianus, *Gaud.*; 211	c							
Krichauffianus, *F. M.*; 216	c							
Sturtii, *Hooker*; 216	c							
Wrayæ, *Lind.*; 217; Frag. ix., 128	c			*a*	*b*		*d*	
Farragei, *F. M.*; Frag. viii., 241	c							
hakeifolius, *Giord.*; 220	c			*a*	*b*			

Gossypium Sturtii, *F. M.*; 222	c			*a*				
australe, *F. M.*; 220	c							
Euphorbiaceæ (Fl. Aust., vol. VI.)								
Euphorbia australis, *Boiss.*; 48	c	M						
Drummondi, *Boiss.*; 49	c	M		*a*		*c*	*d*	
Wheeleri, *Baill.*; 49	c							
eremophila, *A. Cunn.*; 52	c	M		*a*				
Poranthera ericoides, *Klotzsch*; 55			E			*c*		
microphylla, *Brong.*; 56			E	*a*	*b*	*c*	*d*	
Pseudanthus micranthus, *Benth.*; 59						*c*		
Beyeria viscosa, *Miq.*, *var.* opaca; 65	c	M	E		*b*	*c*	*d*	*k*
var. uncinata; 65		M						
Ricinocarpus pinifolius, *Desf.*; 70			E					
Bertya Cunninghami, *Planchon*; 75	c							
oleifolia, *Planchon*; 76		M			*b*	*c*		
rotundifolia, *F. M.*; 77								*k*
Monotaxis luteiflora, *F. M.*; Frag. x., 51	c							
Amperea spartioides, *Brong.*; 84			E					
Phyllanthus calycinus, *Labill.*; 105		M		*a*	*b*			
Fuernrohri, *F. M.*; 107	c	M						
trachspermus, *F. M.*; 108		M						
lacunarius, *F. M.*; 108		M						
thymoides, *Sieb.*; 109		M						
Gunnii, *Hooker*; 110				*a*				
Adriana tomentosa, *Sand.*; 134	c	M						
quadripartita, *Gaud.*; 135			E		*b*	*c*	*d*	*k*
Urticaceæ (Fl. Aust., vol. VI.)								
Ficus platypoda, *A. Cunn.*; 169	c							
orbicularis, *A. Cunn.*; 175	c							
Parietaria debilis, *G. Forst.*; 188	c	M	E		*b*	*c*	*d*	*k*
Sapindaceæ (Fl. Aust., vol. I.)								
Diplopeltis Stuarti, *F. M.*; 456	c							
Atalaya hemiglauca, *F. M.*; 463	c							
Heterodendron oleifolium, *F. M.*; 469	c	M		*a*			*d*	
Dodonæa petiolaris, *F. M.*; 475	c							
viscosa, *Linné*; 475	c	M	E			*c*	*d*	
var. attenuata; 477		M		*a*				*k*
procumbens, *F. M.*; 478			E					
lobulata, *F. M.*; 479	c			*a*	*b*			
bursarifolia, *Behr* and *F. M.*; 482		M				*c*	*d*	
Baueri, *Endlicher*; 482		M	E	*a*	*b*		*d*	
hexandra, *F. M.*; 483					*b*		*d*	
humilis, *Endlicher*; 485				*a*	*b*	*c*	*d*	
boroniæfolia, *G. Don*; 485							*d*	

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Erodium cygnorum, *Nees*; 297	c			*a*	*b*	*c*	*d*	*k*
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var. erodioides, *Hook.*							*d*	
Rodneyanum, *Lind.*; 299						*c*		
Oxalis corniculata, *Linné*; 301	c		E	*a*	*b*	*c*	*d*	
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Tribulus terrestris, *Linné*; 288	c	M	E					
hystrix, *R. Brown*; 289	c							
Zygophyllum apiculatum, *F. M.*; 292	c	M		*a*				
glaucescens, *F. M.*; 293	c	M		*a*	*b*	*c*	*d*	
crenatum, *F. M.*; 293	c	M		*a*			*d*	
iodocarpum, *F. M.*; 293	c	M		*a*				
prismatothecum, *F. M.*; 293				*a*				
Billardieri, *De Cand.*; 293	c	M	E	*a*	*b*	*c*	*d*	*k*
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fruticulosum, *De Cand.*; 294	c	M		*a*	*b*		*d*	
ammophilum, *F. M.*; Fr. xi., 28	c				*b*		*d*	
Nitraria Schoberi, *Linné*; 291	c	M		*a*	*b*	*c*	*d*	*k*
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Zieria veronicea, *F. M.*; 305						*c*		*k*
Boronia Edwardsi, *Benth.*; 312						*c*		
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cærulescens, *F. M.*; 320	c	M	E	*a*	*b*	*c*		
polygalifolia, *Smith*; 320			E			*c*		
filifolia, *F. M.*; 325		M				*c*		*k*
clavellifolia, *F. M.*; 325	c	M			*b*		*d*	
Eriostemon obovalis, *A. Cunn.*; 334		M						
linearis, *A. Cunn.*; 334	c							

Eriostemon difformis, *A. Cunn.*; 335	c	M						
var. (?) teretifolius						c		
pungens, *Lind.*; 338		M				c		
Hillebrandi, *F. M.*; 340						c		
brachyphyllus, *F. M.*; 341					b	c		
lepidotus, *Sprong.*; 342	c	M		a			d	
capitatus, *F. M.*; 346	c				b		d	
Correa æmula, *F. M.*; 353			E			c		
alba, *Andr.*; 354			E			c		k
speciosa, *Ait.*; 354	c		E		b		d	
decumbens, *F. M.*; 356						c		k
Geijera salicifolia, *Schott.*; 364	c	M		a	b	c	d	
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Owenia acidula, *F. M.*; 385	c							
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Didymotheca thesioides, *Hooker*; 145					b		d	
pleiococca, *F. M.*; 146	c	M	E	a	b	c		k
Gyrostemon ramulosus, *Desf.*; 147	c							
Codonocarpus pyramidalis, *F. M.*; 148	c			a				
cotinifolius, *F. M.*; 148	c	M		a				
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multiflora, *Hooker*; 159			E			c		
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apetala, *Linné*; 160						c	d	
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var. marina						c	d	
Polycarpon tetraphyllum, *Linné*; 163					b	c		
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calyptrata, *Hooker*; 174						*c*	*d*	
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diandrum, *F. M.*; 211	c	M		*a*	*b*			
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Euxolus Mitchelli, *F. M.*; 214	c							
Ptilotus obovatus, *F. M.*; 220	c	M	E	*a*	*b*			
alopecuroideus, *F. M.*; 224	c	M	E			*c*		
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exaltatus, *Nees*; 227	c	M						
Beckeri, *F. M.*; 228					*b*			
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helipteroides, *F. M.*; 231	c							
spathulatus, *Poiret*; 236	c	M			*b*	*c*	*d*	
leucocomus, *F. M.*; 238	c							
Hoodii, *F. M.*; Frag. viii., 232	c							
parvifolius, *F. M.*; 241	c							
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latifolius, *R. Brown*; 244	c							
Alternanthera triandra, *Lamarck*; 249	c	M	E			*c*		
sessilis, *R. Brown*; 249	c							
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Gaudichaudiana, *Moq.*; 154	c							
crassifolia, *R. Brown*; 154	c							*k*
spinescens, *R. Brown*; 155	c	M			*b*			
var. deltophylla							*d*	
nutans, *R. Brown*; 156	c	M				*c*	*d*	*k*
Chenopodium nitrariaceum, *F. M.*; 158	c	M					*d*	
microphyllum, *F. M.*; 161		M			*b*	*c*	*d*	
glaucum, *Linné*; 161		M	E			*c*		*k*
carinatum, *R. Brown*; 162	c	M	E			*c*	*d*	

Chenopodium pumilio, *R. Brown*; 163								*k*
cristatum, *F. M.*; 163	c	M		*a*	*b*			
atriplicinum, *F. M.*; 163	c	M		*a*				
Dysphania plantaginella, *F. M.*; 164	c							
littoralis, *R. Brown*; 164	c	M						
myriocephala, *Benth.*; 165		M						
Atriplex stipitatum, *Benth.*; 168	c	M		*a*				
paludosum, *R. Brown*; 169					*b*	*c*	*d*	*k*
var. appendiculatum	c							
nummularium, *Lind.*; 170	c	M						
cinereum, *Poiret*; 171		M	E	*a*	*b*	*c*	*d*	*k*
rhagodioides, *F. M.*; 172		M						
incrassatum, *F. M.*; 172	c							
vesicarium, *Heward*; 172	c	M		*a*				
velutinellum, *F. M.*; 174	c							
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angulatum, *Benth.*; 174		M		*a*				
semibaccatum, *R. Brown*; 175						*c*		
Muelleri, *Benth.*; 175	c	M					*d*	
prostratum, *R. Brown*; 176								*k*
microcarpum, *Benth.*; 176							*d*	
pumilio, *R. Brown*; 176					*b*		*d*	
leptocarpum, *F. M.*; 178		M						
halimoides, *Lind.*; 178	c	M		*a*	*b*			
holocarpum, *F. M.*; 179	c							
spongiosum, *F. M.*; 179	c	M						
Enchylæna tomentosa, *R. Brown*; 181	c	M		*a*	*b*	*c*	*d*	
Chenolea enchylænoides, *F. M.*; 182						*c*	*d*	
Dallachyana, *Benth.*; 191		M						
tricornis, *Benth.*; 191		M						
sclerolænoides, *F. M.*; 192	c	M		*a*				
uniflora, *F. M.*; 194					*b*			
diacantha, *F. M.*; 194	c	M			*b*	*c*	*d*	
bicornis, *F. M.*; 195	c							
biflora, *F. M.*; 196	c	M			*b*			
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bicuspis, *F. M.*; 200	c			*a*				
quinquecuspis, *F. M.*; 199		M						
echinopsila, *F. M.*; 201	c	M						
salsuginosa, *F. M.*; 197		M						
Threlkeldia diffusa, *R. Brown*; 197						*c*		
Babbagia dipterocarpa, *F. M.*; 192	c							
Kochia fimbriolata, *F. M.*; Frag. ix., 75	c							
lobiflora, *F. M.*; 184	c							
lanosa, *Lind.*; 184	c	M						
triptera, *Benth.*; 185	c	M.						

Kochia oppositifolia, *F. M.*; 185		M		*a*	*b*	*c*	*d*
brevifolia, *R. Brown*; 185		M		*a*	*b*	*c*	*d*
pyramidata, *Benth.*; 186		M					
eriantha, *F. M.*; 186	c						
appressa, *Benth.*; 188	c						
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ciliata, *F. M.*; 188	c						
brachyptera, *F. M.*; 189	c	M		*a*			
stelligera, *F. M.*; 189		M					
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arbuscula, *R. Brown*; 203	c	M	E		*b*	*c*	*d*
tenuis, *Benth.*; 204	c						
australis, *Soland.*; 205	c		E		*b*	*c*	*d*
Suæda maritima, *Dumort.*; 206			E		*b*		*d*
Salsola Kali, *Linné*; 207	c	M	E	*a*	*b*	*c*	*d*
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æquilaterale, *Haw.*; 324	c	M	E	*a*	*b*	*c*	*d*
Tetragonia expansa, *Murray*; 325	c	M		*a*			
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crystallina, *Vahl.*; 330	c						
Mollugo orygioides, *F. M.*; 333	c						
Glinus, *A. Rich.*; 333	c	M		*a*			
Spergula, *Linné*; 334		M					
Cerviana, *Ser.*; 334	c	M					
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prostratum, *R. Brown*; 268		M					
hydropiper, *Linné*; 269			E				
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Muhlenbeckia adpressa, *Meissner*; 273	c		E	*a*	*b*	*c*	*d* *k*
polygonoides, *F. M.*; 275		M					
Cunninghami, *F. M.*; 276		M			*b*	*c*	

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Isotropis atropurpurea, *F. M.*; 40	c							
Wheeleri, *F. M.*; 40	c							
Gompholobium minus, *Smith*; 45	c	M	E			*c*		*k*
Burtonia polyzyga, *Benth.*; 50	c							
Sphærolobium vimineum, *Smith*; 65		M				*c*		
Viminaria denudata, *Smith*; 68			E			*c*		
Daviesia arthropoda, *F. M.*; Frag. viii., 225	c							
corymbosa, *Smith*; 76				*a*		*c*		
ulicina, *Smith*; 81		M	E	*a*		*c*		
genistifolia, *A. Cunn.*; 82			E	*a*			*d*	
incrassata, *Smith*; 83					*b*			*k*
brevifolia, *Lind.*; 84		M	E			*c*		
pectinata, *Lind.*; 87					*b*			
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pleurandroides, *F. M.*; 96			E		*b*	*c*		*k*
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laxiflora, *Benth.*; 133						*c*		
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densifolia, *F. M.*; 136		M			*b*	*c*		
villifera, *Sieb.*; 137					*b*	*c*		
involucrata, *Benth.*; 138						*c*		
prostrata, *Benth.*; 138		M						
canaliculata, *F. M.*; 139						*c*		
tenuifolia, *R. Brown*; 139		M	E		*b*	*c*	*d*	*k*
Eutaxia empetrifolia, *Schlecht.*; 145		M			*b*	*c*	*d*	
Dillwynia hispida, *Lind.*; 147		M	E		*b*	*c*		
ericifolia, *Smith*; 147			E					
floribunda, *Smith*; 149			E			*c*		*k*

Dillwynia cinerascens, *R. Brown*; 151			E					
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Platylobium triangulare, *R. Brown*; 152			E					
obtusangulum, *Hooker*; 153			E			*c*		*k*
Bossiæa cinerea, *R. Brown*; 160			E					
prostrata, *R. Brown*; 162			E			*c*		
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Templetonia retusa, *R. Brown*; 169	c			*a*	*b*			
egena, *Benth.*; 170	c	M		*a*	*b*			
sulcata, *Benth.*; 171		M					*d*	
Hovea longifolia, *R. Brown*; 172		M		*a*				
heterophylla, *A. Cunn.*; 172			E					
Goodia lotifolia, *Salisb.*; 177			E	*a*		*c*		
medicaginea, *F. M.*; Frag. i., 10			E			*c*		*k*
Crotalaria Cunninghami, *R. Brown*; 182	c							
dissitiflora, *Benth.*; 184	c							
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Lotus australis, *Andr.*; 188	c		E	*a*		*c*	*d*	*k*
var. Behrianus		M				*c*	*d*	
Psoralea balsamica, *F. M.*; 191	c							
eriantha, *Benth.*; 192	c	M	E					
patens, *Lind.*; 192	c	M	E	*a*	*b*	*c*		
leucantha, *F. M.*; 193	c							
adscendens, *F. M.*; 193			E			*c*		
Indigofera enneaphylla, *Linné*; 196	c							
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monophylla, *De Cand.*; 199	c							
australis, *Willd.*; 199	c		E			*c*	*d*	
brevidens, *Benth.*; 200	c							
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phacoides, *Benth.*; 217	c	M					*d*	
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campylantha, *F. M.*; 219	c							
procumbens, *F. M.*; 220			E	*a*	*b*	*c*		
phacifolia, *F. M.*; 221	c			*a*				
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circinata, *Benth.*; 286		M						
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var. heteroloba		M				*c*	*d*	
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Sturtii, *R. Brown*; 288	c	M		*a*	*b*			
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Podotheca angustifolia, *Cass.*; 601		M				*c*	*d*	
Podolepis acuminata, *R. Brown*; 604			E			*c*	*d*	
canescens, *A. Cunn.*; 605	c	M	E	*a*	*b*	*c*	*d*	
rugata, *Labill.*; 606		M		*a*	*b*	*c*	*d*	
Lessoni, *Benth.*; 606				*a*		*c*	*d*	
Siemssenia, *F. M.*; 607	c			*a*				
Leptorhynchus squamatus, *Labill.*; 608						*c*	*d*	
ambiguus, *Turcz.*; 609	c			*a*				
pulchellus, *F. M.*; 610		M		*a*	*b*	*c*	*d*	
elongatus, *DeC.*; 616, Fg. xi., 85				*a*		*c*	*d*	
medius, *A. Cunn.*; 610, Fg. xi., 85	c						*d*	
Waitzia, *Sonder.*; 610		M		*a*	*b*	*c*	*d*	
Helichrysum Cassinianum, *Gaud.*; 611	c							
Davenporti, *F. M.*; 616	c							
semifertile, *F. M.*; 617	c			*a*				
Baxteri, *A. Cunn.*; 617		M		*a*		*c*	*d*	
scorpioides, *Labill.*; 618			E			*c*		
rutidolepis, *De Cand.*; 618	c					*c*		
obtusifolium, *F. M. & Sond.*; 619			E			*c*	*d*	*k*
lucidum, *Henckel*; 620	c	M	E	*a*	*b*	*c*	*d*	
retusum. *F. M.*; Frag. viii., 46		M		*a*	*b*	*c*	*d*	
decurrens, *F. M.*; Frg. viii., 46		M						
diotophyllum, *F. M.*; 628		M						
adenophorum, *F. M.*; 622								*k*
leucopsidium, *De Cand.*; 622		M	E	*a*	*b*	*c*	*d*	
Blandowskianum, *Steetz*; 622			E			*c*		
podolepideum, *F. M.*; 624	c							
apiculatum, *De Cand.*; 624	c	M	E	*a*	*b*	*c*	*d*	
semipapposum, *De Cand.*; 625		M	E	*a*	*b*	*c*	*d*	
ferrugineum, *Labill.*; 631			E					
Thomsoni, *F. M.*; Fg. viii., 45	c							

Helichrysum Ayersii, *F. M.*; Fg. viii., 167	c							
Waitzia corymbosa, *Wendl.*; 635	c							
Helipterum roseum, *Benth.*; 640	c							
anthemoides, *De Cand.*; 641		M		*a*		*c*		
polygalifolium, *De Cand.*; 641	c	M			*b*			
floribundum, *De Cand.*; 642	c	M		*a*			*d*	
var. Stuartinum, *Sond.*		M						
heteranthum, *Turcz.*; 642							*d*	
involucratum, *F. M.*; 646	c							
tenellum, *Turcz.*; 646	c				*b*			
strictum, *Benth.*; 646	c			*a*				
stipitatum, *F. M.*; 643	c							
incanum, *De Cand.*; 643	c	M		*a*				
Cotula, *De Cand.*; 644	c	M						
hyalospermum, *F. M.*; 644	c			*a*		*c*	*d*	
Haigii, *F. M.*; Frag. x., 107	c							
corymbiflorum, *Schlecht.*; 647				*a*		*c*	*d*	
pygmæum, *De Cand.*; 647		M		*a*	*b*	*c*	*d*	
Charsleyæ, *F. M.*; Fg. viii., 168	c							
moschatum, *A. Cunn.*; 648	c			*a*		*c*		
Tietkensi, *F. M.*; Fg. viii., 227	c							
pterochætum, *F. M.*; 648	c			*a*				
exiguum, *F. M.*; 649	c		E			*c*	*d*	
dimorpholepis, *Benth.*; 650				*a*			*d*	
Gnaphalium luteo-album, *Linné*; 653	c	M	E	*a*	*b*	*c*	*d*	*k*
Japonicum, *Thunb.*; 653	c		E		*b*	*c*	*d*	*k*
indutum, *Hooker*; 655		M	E	*a*			*d*	
Stuartina Muelleri, *Sonder.*; 657			E	*a*		*c*	*d*	
Erechthites picridioides, *Turcz.*; 658	c						*d*	
arguta, *De Cand.*; 659	c		E	*a*		*c*		*k*
mixta, *De Cand.*; 659		M			*b*			
quadridentata, *De Cand.*; 660				*a*		*c*	*d*	
hispidula, *De Cand.*; 660						*c*	*d*	
Senecio Gregorii, *F. M.*; 663	c							
megaglossus, *F. M.*; 665				*a*				
magnificus, *F. M.*; 665	c			*a*				
lautus, *G. Forst.*; 667	c	M	E		*b*	*c*	*d*	*k*
Behrianus, *Sond. & Muell.*; 669		M						
brachyglossus, *F. M.*; 669	c	M		*a*	*b*	*c*	*d*	
Georgianus, *De Cand.*; 670		M				*c*		
odoratus, *Hornem.*; 671	c		E		*b*	*c*		*k*
hypoleucus, *Benth.*; 672						*c*		
Cunninghami, *De Cand.*; 671	c	M		*a*		*c*	*d*	
anethifolius, *A. Cunn.*; 672				*a*				
Cymbonotus Lawsonianus, *Gaudich.*; 674						*c*	*d*	
Microseris Forsteri, *Hooker*; 676		M	E	*a*		*c*	*d*	
Picris hieracioides, *Linné*; 678		M	E		*b*	*c*	*d*	*k*

Stylidieæ (Fl. Aust., vol. IV.)								
Stylidium graminifolium, *Swartz*; 10			E			*c*		
calcaratum, *R. Brown*; 14						*c*		
floribundum, *R. Brown*; 15	c							
despectum, *R. Brown*; 22			E	*a*		*c*		
Leeuwenhookia dubia, *Sonder*; 84		M	E			*c*	*d*	
Campanulaceæ (Fl. Aust., vol. IV.)								
Lobelia heterophylla, *Labill.*; 124	c							
Browniana, *Roem. & Schult.*			E					
microsperma, *F. M.*; Frag. x., 41					*b*	*c*	*d*	*k*
simplicicaulis, *R. Brown*; 124			E					
rhombifolia, *De Vr.*; 126						*c*		
anceps, *Thunb.*; 128			E		*b*	*c*		*k*
pratioides, *Benth.*; 131			E					
Benthami, *F. M.*; 133 *(puberula)*	c							
concolor, *R. Brown*; 133		M						
Isotoma petræa, *F. M.*; 135	c			*a*				
scapigera, *Don*; 136					*b*			
fluviatilis, *F. M.*; 136			E					
Wahlenbergia gracilis, *De Cand.*; 137	c	M	E	*a*	*b*	*c*	*d*	
Goodenovieæ (Fl. Aust., vol. IV.)								
Leschenaultia divaricata, *F. M.*; 43	c							
striata, *F. M.*; Fg. viii., 245	c							
Velleia connata, *F. M.*; 46	c							
paradoxa, *R. Brown*; 48		M	E		*b*	*c*	*d*	
Goodenia Rameli, *F. M.*; 57	c							
ovata, *Smith*; 59			E			*c*	*d*	*k*
amplexans, *F. M.*; 60						*c*		
varia, *R. Brown*; 61	c	M		*a*	*b*	*c*		
geniculata, *R. Brown*; 62		M	E	*a*	*b*	*c*	*d*	
hirsuta, *F. M.*; 64	c							
Vilmoriniæ, *F. M*; 68	c							
Nicholsoni, *F. M.*; 69	c							
grandiflora, *Sims*; 69	c							
Chambersi, *F. M.*; 70	c							
calcarata, *F. M.*; 69	c			*a*				
albiflora, *Schlecht.*; 70						*c*	*d*	
Mitchelli, *Benth.*; 71	c							
heterochila, *F. M.*; 71	c							
Mueckeana, *F. M.*; Frag. viii., 56	c							
cycloptera, *R. Brown*; 74	c						*d*	
pinnatifida, *Schlecht.*; 75		M		*a*	*b*	*c*	*d*	
glauca, *F. M.*; 76	c	M						
microptera, *F. M.*; 77	c							

Selliera radicans, *Cav.*; 82					*b*	*c*		
Catosperma Muelleri, *Benth.*; 83	c							
Scævola spinescens, *R. Brown*; 87	c	M		*a*	*b*		*d*	
depauperata, *R. Brown*; 91	c							
parvifolia, *F. M.*; 91	c							
collaris, *F. M.*; 92	c							
suaveolens, *R. Brown*; 95		M	E					
ovalifolia, *R. Brown*; 96	c							
crassifolia, *Labill.*; 96	c		E	*a*	*b*	*c*	*d*	
æmula, *R. Brown*; 99	c		E	*a*	*b*			
humilis, *R. Brown*; 100	c				*b*			
microcarpa, *Cav.*; 101			E	*a*		*c*		
linearis, *R. Brown*; 102					*b*	*c*		*k*
Dampiera lanceolata, *A. Cunn.*; 113		M						
rosmarinifolia, *Schlecht.*; 114	c	M	E	*a*	*b*	*c*	*d*	
stricta, *R. Brown*; 115			E					
Brunonia australis, *Smith*; 121	c		E			*c*		
GENTIANEÆ (Fl. Aust., vol. IV.)								
Sebæa ovata, *R. Brown*; 371		M	E			*c*	*d*	*k*
Erythræa australis, *R. Brown*; 371	c		E	*a*	*b*	*c*	*d*	
Gentiana montana, *G. Forst.*; 373		M	E					
Limnanthemum exaltatum, *F. M.*; 376		M	E			*c*		
crenatum, *F. M.*; 379		M						
LOGANIACEÆ (Fl. Aust., vol. IV.)								
Mitrasacme paradoxa, *R. Brown*; 359			E	*a*				
Logania longifolia, *R. Brown*; 361				*a*		*c*		
crassifolia, *R. Brown*; 362		M	E		*b*			
ovata, *R. Brown*; 362			E		*b*	*c*	*d*	*k*
linifolia, *Schlecht.*; 363		M				*c*	*d*	
nuda, *F. M.*; 365		M						
PLANTAGINEÆ (Fl. Aust., vol. V.)								
Plantago varia, *R. Brown*; 139	c	M	E	*a*	*b*	*c*	*d*	*k*
var. (?) parviflora								*k*
PRIMULACEÆ (Fl. Aust., vol. IV.)								
Samolus repens, *Pers.*; 271	c	M	E		*b*	*c*	*d*	
JASMINEÆ (Fl. Aust., vol. IV.)								
Jasminum lineare, *R. Brown*; 295	c							
calcareum, *F. M.*; 297	c							
APOCYNEÆ (Fl. Aust., vol. IV.)								
Carissa Brownii, *F. M.*; 305	c							
Alyxia buxifolia, *R. Brown*; 307	c	M	E	*a*	*b*	*c*	*d*	

Notonerium Gossei, *Benth.*; Gen. Plant., 698	c							
Asclepiadeæ (Fl. Aust., vol. IV.)								
Sarcostemma australe, *R. Brown*; 328	c			*a*				
Cynanchum floribundum, *R. Brown*; 332	c			*a*				
Marsdenia Leichhardtiana, *F. M.*; 341	c							
Solanaceæ (Fl. Aust., vol. IV.)								
Solanum aviculare, *G. Forst.*; 447			E					
simile, *F. M.*; 448	c	M		*a*	*b*		*d*	*k*
fasciculatum, *F. M.*; Frag. vi., 144	c						*d*	
ferocissimum, *Lindley*; 451	c							
oligacanthum, *F. M.*; 454	c							
esuriale, *Lindley*; 454	c	M		*a*	*b*	?		
chenopodinum, *F. M.*; 454	c							
Sturtii, *F. M.*; 454	c			*a*				
hystrix, *R. Brown*; 458					*b*			
eremophilum, *F. M.*; 459				*a*				
lacunarium, *F. M.*; 461	c							
petrophilum, *F. M.*; 461	c			*a*				
ellipticum, *R. Brown*; 464	c			*a*				
Lycium australe, *F. M.*; 467	c	M				*c*	*d*	
Datura Leichhardti, *F. M.*; 468	c							
Nicotiana sauveolens, *Lehm.*; 469	c	M	E	*a*	*b*	*c*	*d*	
Anthocercis anisantha, *Endlicher*; 477	c				*b*			
angustifolia, *F. M.*; 478						*c*		
myosotidea, *F. M.*; 478		M						
Eadesii, *F. M.*; 480		M						
Duboisia Hopwoodi, *F. M.*; 480	c							
Anthrotroche Blackii, *F. M.*; Frag. viii., 282	c							
Scrophulariaceæ (Fl. Aust., vol. IV.)								
Mimulus repens, *R. Brown*; 482	c	M		*a*	*b*	*c*		
gracilis, *R. Brown*; 482	c							
prostratus, *Benth.*; 483	c							
Stemodia viscosa, *Rosb.*; 486	c							
pedicellaris, *F. M.*; Frag. viii., 231	c							
Morgania, *F. M.*; 488	c			*a*		*c*		
Gratiola peruviana, *Linné*; 493			E			*c*		*k*
Limosella aquatica, *Linné*; 503		M		*a*		*c*		*k*
Curdieana, *F. M.*; Frag. ix., 166	c	M						
Veronica decorosa, *F. M.*; 506				*a*				
Derwentia, *Littlejohn*; 507			E			*c*		
gracilis, *R. Brown*; 508			E			*c*		
distans, *R. Brown*; 509		M		*a*	*b*			
calycina, *R. Brown*; 509			E				*d*	*k*
Euphrasia Brownii, *F. M.*; 520	c	M	E	*a*	*b*	*c*	*d*	

Euphrasia scabra, *R. Brown*; 521			E		*b*	*c*	
Acanthaceæ (Fl. Aust., vol. IV.)							
Ruellia australis, *R. Brown*; 547	c						
Justicia procumbens, *Linné*; 549	c			*a*			
Kempeana, *F. M.*; Frag. xi., 101	c						
Orobanchaceæ (Fl. Aust., vol. IV.)							
Orobanche cernua, *Loefl.*; 533	c			*a*			*d*
Lentibulariaceæ (Fl. Aust., vol. IV.)							
Utricularia flexuosa, *Vahl.*; 525			E				
dichotoma, *Labill.*; 529			E				
Polypompholyx tenella, *Lehm.*; 532						*c*	
Bignoniaceæ (Fl. Aust., vol. IV.)							
Tecoma australis, *R. Brown*; 537	c						
Pedalineæ (Fl. Aust., vol. IV.)							
Josephinia Eugeniæ, *F. M.*; 557				*a*			
Convolvulaceæ (Fl. Aust., vol. IV.)							
Ipomœa Davenporti, *F. M.*; 415	c						
costata, *F. M.*; 419	c						
Muelleri, *Benth.*; 423	c						
heterophylla, *R. Brown*; 426	c						
Convolvulus erubescens, *Sims*; 429	c	M	E	*a*	*b*	*c*	*d*
sepium, *Linné*; 430		M	E				
Breweria rosea, *F. M.*; 436	c						
Cressa cretica, *Linné*; 437		M				*c*	
Evolvulus linifolius, *Linné*; 437	c						
Dichondra repens, *G. Forst.*; 438			E			*c*	
Wilsonia humilis, *R. Brown*; 439		M		*a*	*b*	*c*	
rotundifolia, *Hooker*; 440						*c*	*d*
Cuscuta australis, *R. Brown*; 441			E				
Boragineæ (Fl. Aust., vol. IV.)							
Coldenia procumbens, *Linné*; 391	c						
Heliotropium Curassavicum, *Linné*; 393	c	M	E				
europæum, *Linné*; 394	c	M		*a*		[*c*]	
undulatum, *Vahl.*; 394	c						
asperrimum, *R. Brown*; 394	c			*a*			
ovalifolium, *Forst.*; 396	c						
filaginoides, *Benth.*; 398	c						
pleiopterum, *F.M.*; Fg.ix.,121	c						
Halgania anagalloides, *Endl.*; 402	c						
cyanea, *Lindley*; 402	c	M		*a*	*b*		*d*

Halgania lavandulacea, *Endl.*; 403	c						*d*	
Trichodesma Zeylanicum, *R. Brown*; 404	c			*a*				
Myosotis australis, *R. Brown*; 405		M	E			*c*	*d*	
Eritrichium australasicum, *De Cand.*; 406		M		*a*			*d*	
Echinospermum concavum, *F. M.*; 407		M			*b*	*c*	*d*	
Cynoglossum suaveolens, *R. Brown*; 409		M			*b*	*c*	*d*	
australe, *R. Brown*; 409			E					
Drummondi, *Benth.*; 409	c	M		*a*				
LABIATÆ (Fl. Aust., vol. V.)								
Plectranthus parviflorus, *Henckel*; 78	c							
Mentha grandiflora, *Benth.*; 82	c							
australis, *R. Brown*; 83	c	M	E			*c*		
gracilis, *R. Brown*; 83			E			*c*		
satureioides, *R. Brown*; 84			E		*b*	*c*	*d*	
Lycopus australis, *R. Brown*; 85			E			*c*		
Prunella vulgaris, *Linné*; 87			E			*c*		
Scutellaria mollis, *R. Brown*; 88			E					
humilis, *R. Brown*; 88								*k*
Prostanthera lasianthos, *Labill.*; 93			E					
rotundifolia, *R. Brown*; 96		M						
spinosa, *F. M.*; 99		M			*b*			*k*
Behriana, *Schlecht.*; 102		M				*c*		
Wilkieana, *F. M.*; Fg. viii., 230	c							
Baxteri, *A. Cunn.*; 102	c							
striatiflora, *F. M.*; 102	c			*a*				
eurybioides, *F. M.*; 105		M				*c*		
coccinea, *F. M.*; 107		M			*b*	*c*	*d*	*k*
calycina, *F. M.*; 107					*b*			
Microcorys Macredieana, *F. M.*; Fg. viii., 231	c							
Westringia rigida, *R. Brown*; 129	c	M			*b*	*c*	*d*	
Dampieri, *R. Brown*; 129	c				*b*			
Teucrium racemosum, *R. Brown*; 132	c	M			*b*	*c*	*d*	
corymbosum, *R. Brown*; 133	c		E	*a*				
sessiliflorum, *Benth.*; 134				*a*	*b*		*d*	
Ajuga australis, *R. Brown*; 136		M	E	*a*		*c*		*k*
VERBENACEÆ (Fl. Aust., vol. V.)								
Verbena officinalis, *Linné*; 86	c	M		*a*		[*c*]		
Newcastlia spodiotricha, *F. M.*; 40	c							
bracteosa, *F. M.*; Frag. viii., 49	c							
cephalantha, *F. M.*; Frag. ix., 4	c							
Dicrastyles ochrotricha, *F. M.*; 42	c							
Beveridgei, *F. M.*; Frag. viii., 50	c							
Gilesii, *F. M.*; Frag. viii., 229	c							
Dorani, *F. M.*; Frag. viii., 230	c							
Lewellini, *F. M.*; Frag. xi.; 86	c							

Avicennia officinalis, *Linné*; 69				*a*	*b*	*c*	*d*	
MYOPORINÆ (Fl. Aust., vol. V.)								
Myoporum Cunninghami, *Benth.*; 4	c							
insulare, *R. Brown*; 4			E	*a*	*b*	*c*	*d*	
viscosum, *R. Brown*; 5			E	*a*	*b*		*d*	*k*
deserti, *A. Cunn.*; 5	c	M		*a*		*c*	*d*	
parvifolium, *R. Brown*; 6	c	M	E	*a*	*b*	*c*	*d*	
brevipes, *Benth.*; 6	c							
platycarpum, *R. Brown*; 7	c	M		*a*	*b*		*d*	
Eremophila Dalyana, *F. M.*; 10	c							
scoparia, *F. M.*; 10	c	M		*a*	*b*			
Delisseri, *F. M.*; 11	c							
Weldii, *F. M.*; Frag. vii., 109	c							
crassifolia, *F. M.*; 11					*b*			
Behriana, *F. M.*; 12					*b*	*c*	*d*	*k*
Christophori, *F. M.*; Fg. ix., 120	c							
densifolia, *F. M.*; 13	c							*k*
gibbifolia, *F. M.*; 13		M				*c*		
divaricata, *F. M.*; 14		M						
santalina, *F. M.*; 15				*a*				
rotundifolia, *F. M.*; 19	c							
oppositifolia, *R. Brown*; 20	c			*a*				
Paisleyi, *F. M.*; 20	c							
Sturtii, *R. Brown*; 21	c							
Hughesii, *F. M.*; Frag. viii., 228	c							
Gibsoni, *F. M.*; Frag. viii., 227	c							
Gilesii, *F. M.*; Frag. viii., 49	c							
Berryi, *F. M.*; Frag. viii., 228	c							
Latrobei, *F. M.*; 22	c							
MacDonnelli, *F. M.*; 22	c							
longifolia, *F. M.*; 23	c				*b*		*d*	
polyclada, *F. M.*; 24	c							
Freelingi, *F. M.*; 25	c							
viridifolia, *F. M.*							*d*	
Goodwini, *F. M.*; 25	c							
Elderi, *F. M.*; Frag. viii,, 228	c							
Willsii, *F. M.*; 26	c							
Brownii, *F. M.*; 27	c	M		*a*	*b*		*d*	*k*
Duttoni, *F. M.*; 28	c							
maculata, *F. M.*; 29	c	M						
latifolia, *F. M.*; 30	c			*a*				
alternifolia, *R. Brown*; 30	c	M		*a*				
EPACRIDEÆ (Fl. Aust., vol. IV.)								
Styphelia adscendens, *R. Brown*; 146			E					
pusilliflora, *F. M.*; 149			E					

Styphelia humifusa, *Pers.*; 156		M	E	*a*	*b*	*c*	*d*	*k*
Sonderi, *F. M.*; 158	c	M	E			*c*		*k*
strigosa, *Smith*; 175						*c*		
Richei, *Labill.*; 186		M	E	*a*	*b*	*c*		*k*
australis, *F. M.*; 186			E			*c*		
collina, *Labill.*; 191			E					
concurva, *F. M.*; 198						*c*		
virgata, *Labill.*; 201		M				*c*		
ericoides, *Smith*; 200			E					
cordifolia, *F. M.*; 214	c	M		*a*	*b*	*c*	*d*	
hirtella, *F. M.*; 218						*c*		
rufa, *F. M.*; 220				*a*	*b*	*c*		*k*
Woodsii, *F. M.*; 225			E					
serrulata, *Labill.*; 227						*c*		
patula, *Spreng.*; 227					*b*	*c*	*d*	*k*
ovalifolia, *Spreng.*; 228		M	E		*b*		*d*	
depressa, *Spreng.*; 228		M				*c*		*k*
fasciculiflora, *F. M.*; 229						*c*		
Monotoca elliptica, *R. Brown*; 230			E					
Brachyloma ericoides, *Sond.*; 172		M				*c*		*k*
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Epacris impressa, *Labill.*; 235		M	E			*c*		
obtusifolia, *Smith*; 237			E			*c*		
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microphylla, *R. Brown*; 240			E					
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suberosa, *Ott. & Dietr.*; 197		M						
distyla, *Vent.*; 198			E			*c*	*d*	*k*
torulosa, *Ait.*; 200					*b*			
Decaisneana, *F. M.*; 201	c							
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Cymbidium canaliculatum, *R. Brown*; 302	c						
Calochilus Robertsoni, *Benth.*; 315			E				
Thelymitra ixioides, *Sw.*; 317			E				
aristata, *Lind.*; 319			E			c	
longifolia, *Forster*; 319		M	E	*a*		c	d
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carnea, *R. Brown*; 321						c	
flexuosa, *Endl.*; 322			E			c	
antennifera, *J. Hooker*; 322		M				c	d
Diuris palustris, *Lind.*; 327		M		*a*		c	d
maculata, *Smith*; 327			E			c	d
pedunculata, *R. Brown*; 328			E			c	
sulphurea, *R. Brown*; 330			E				
longifolia, *R. Brown*; 331			E			c	
Orthoceras strictum, *R. Brown*; 332					*b*	c	
Cryptostylis longifolia, *R. Brown*; 338			E				
Prasophyllum elatum, *R. Brown*; 337			E			c	
patens, *R. Brown*; 339			E			c	d
fuscum, *R. Brown*; 339						c	
nigricans, *R. Brown*; 343					*b*		
Tepperi, *F. M. (m.s.)*							d
Microtis porrifolia, *Spreng.*; 347		M				c	d
atrata, *Lind.*; 349			E				
Corysanthes pruinosa, *A. Cunn.*; 351		M				c	
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curta, *R. Brown*; 355						c	
nutans, *R. Brown*; 356			E				
nana, *R. Brown*; 357			E				
cucullata, *R. Brown*; 357						c	
reflexa, *R. Brown*; 359						c	d
barbata, *Lind.*; 362						c	d
mutica, *R. Brown*; 363			E				d
rufa, *R. Brown*; 363				*a*		c	d
var. Mitchelli						c	d
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carnea, *R. Brown*; 386				E			c	d	k
deformis, *R. Brown*; 388			M	E			c	d	
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pedunculatum, *R. Brown*; 455			M						
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Burchardia umbellata, *R. Brown*; 33			M			b	c	d	
Bulbine bulbosa, *Haw.*; 34				E		b	c	d	
semibarbata, *Haw.*; 35		c		E		b	c	d	k
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exasperatus, *F. M.*; 42					a			d	
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Patersoni, *R. Brown*; 43			M	E			c	d	
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decompositum, *Spreng.*; 758			E					
Polypodium punctatum, *Thunb.*; 764			E					
Grammitis Reynoldsi, *F. M.*; 775	c							
rutæfolia, *R. Brown*; 775	c	M				c	d	
leptophylla, *Swartz*; 776						c		

SUPPLEMENTAL LIST OF SPECIES.

CRUCIFERÆ.								
Barbarea vulgaris, *R. Brown*; 66						c		
CAPPARIDEÆ.								
Capparis spinosa, *Linné*; 94 (nummularia)	c							
CARYOPHYLLEÆ.								
Drymaria filiformis, *Benth.*; 162							d	
EUPHORBIACEÆ.								
Phyllanthus rhytidospermus, *F. M.*; 100	c							
SAPINDACEÆ.								
Dodonæa lanceolata, *F. M.*; 475	c							
Tepperi, *F. M. (m.s.)*							d	
CHENOPODIACEÆ.								
Kochia humillima, *F. M.*; Frag. ix., 168							d	
FICOIDEÆ.								
Trianthema humillima, *F. M.*; Frag. x., 78							d	

Umbelliferæ.								
Hydrocotyle rugulosa, *Turcz.*; 344								*d*
Leguminosæ.								
Crotalaria medicaginea, *Willd.*; 188	c							
Indigofera linifolia, *Retz.*; 195	c							
Tephrosia purpurea, *Pers.*; 209	c							
Rhynchosia minima, *De Cand.*; 267	c							

N.B.—The total number of species contained in the foregoing lists is 1,599.

ADDENDA TO GEOGRAPHICAL COLUMNS.

Region M. *Clematis microphylla; Hibbertia densiflora, H. acicularis; Drosera glanduligera, D. Whittakeri; Poranthera microphylla; Adriana quadripartita; Geranium dissectum; Pelargonium australe; Zygophyllum ammophilum; Swainsona lessertiifolia; Kennedya prostrata; Alchemilla arvensis; Tillæa verticillaris; Callitriche verna; Cotula australis; Gnaphalium Japonicum; Stuartina Muelleri; Myoporum viscosum*; *Marsilea quadrifolia.*

Region C. *Abutilon Fraseri; Claytonia corrigiolacea; Chenolea paradoxa.*

Region S *c. Hibbertia acicularis.*

Region S *d. Geococcus pusillus*; *Eucalyptus dumosa; Claytonia pygmæa; Stylidium calcaratum; Controlepis aristata;* and 16 others, for which see Mr. Tepper's Supplement to Plants about Ardrossan.

The figures in the tables on pages 49 and 50 are no longer correct; but as the deductions based upon them are not materially affected by the new reading, a revision of them is deferred to a future occasion. In the meanwhile, the compiler solicits the assistance of all botanists to make the geographical lists as complete as possible.

ERRATA

p. 54, line 21, for trachspermus read trachyspermus.
line 25, for *Sand.* read *Gaud.*
p. 71, line 10, for 540 read 549.

THE "BAY OF BISCAY" SOIL

OF SOUTH AUSTRALIA, AND ITS FORMATION.

By OTTO TEPPER, F.L.S., Corr. Member.

[Read June 1, 1880.]

INTRODUCTORY CITATION.

"I may remark in connection with the clays overlying the Miocene limestone that it is on their surfaces that the 'Bay of Biscay' land prevails. This name is applied to tracts covered with mounds or ridges grouped in the most irregular way, and without any relation to the natural slope of the surface. The ridges, which rarely exceed a foot in height, are composed of clay, while the depressions are occupied by alluvium or sandy loam; and though it is generally held that the soil of the depressions extend in depth, yet my observations are totally opposed to that view. How the depressions have been formed on the clay soil, and how they have been partially filled, are questions which, I hope, will occupy the attention of some member of this Society."—Prof. R. Tate, F.G.S.; President's Anniversary Address Trans. A. Phil. Soc., 1878-9, page lx.

In many parts of South Australia a clayey soil occurs, which is popularly called by the above name, and is justly regarded by most people as one of the most productive. Among other localities we meet it in the undulating Tertiary regions north of Gawler, in the neighbourhood of Tanunda, Greenock, Sheaoak Log, Freeling (villages north of Adelaide), and extending far beyond Kapunda. Again, the same soil is found in small patches near Ardrossan, Yorke's Peninsula. Maitland, in the centre of the same peninsula, is surrounded by it, from whence it stretches into the neighbouring hundreds. In fact, it is found to a greater or less extent in many counties, but the above localities have been examined by me.

Its most characteristic feature is the unevenness of its surface, forming shallow round depressions 6 to 18 inches in depth, and without an outlet. These are surrounded by elevations of varying width, sometimes forming almost ridges, at others equalling or exceeding the depressions in area. The sides are never steep; but frequently one incline is longer than the other, then the shorter one is also the steeper. We meet this surface formation on the broad gently-rounded summit of hills, as well as on almost level gradually rising plains, bounded

on two or three sides by lower ground; and sometimes on the inclines of the hills.

Under the last-mentioned circumstances the said inclines are either very gradual or in terraces. As long as the ground remains in its pristine state, very few or no watercourse are distinguishable; those found are very wide, shallow, and carry very little water. But as soon as the continuity of the turf, noted for its luxuriance, is broken by the farmer's plough, the traveller's dray, or an exceptionally heavy thunderstorm, the bed rapidly deepens, on account of the peculiar nature of the soil, and in a short time assumes respectable dimensions, specially remarkable for the steepness of its banks. If not carefully attended to, the denudation proceeds at so rapid a rate that perhaps in less than a century the whole surface of these regions would, for a considerable depth, be carried out to sea. The cause of this lies in the constitution of the soil. It consists of a dark-red or brown clay, containing much lime and a little fine gravel. Some portions are almost black, other patches grey or bluish. The former occupy generally a part of the elevation and inner slope, sometimes the lowest part also; the latter the remaining part of the slope, generally that facing the higher level of the whole area. However, even where the differences in colour are less marked, a newly-ploughed field of virgin soil of this description presents, when viewed from some distance, always a curious irregularly mottled appearance.

When dry the whole surface is scored in every direction by numerous cracks, often from one to two inches wide, and extending to a considerable depth. The light-coloured patches are much less affected than the darker, but all are rendered in proportion more or less friable and yielding to a most fatiguing extent for weary travellers, &c., and in a very short time the feet of animals and the wheels of vehicles triturate it into incredibly minute particles, forming clouds of dust. If a heavy shower of rain fall for an hour or two the whole surface is changed into an exceedingly adhesive mire, heavily clogging feet and wheels with tough pug. Owing to the uneven surface the water is detained, and a large quantity at once percolates through the larger and smaller cracks, carrying with it a considerable moiety of the loose soil to some depth, and widening the channel in the descent. In the narrower portions of the latter, grass leaves, stray pebbles, &c., will be arrested, and will prevent the closing of the fissure, when the clay expands on saturation, and will facilitate its reopening when the clay shrinks on drying. Actual repeated observations seem to demonstrate that at least the larger of these fissures *do* open year after year, and are productive at times of rather practical annoyances. Thus a large crack through

two opposite walls eighteen inches thick in a house of an acquaintance opens out wide every summer and contracts closely every winter. Some large cracks had been observed in the ground before building but were regarded as superficial merely. Whence do these fissures lead? Direct observations prove that these adhesive clays are succeeded by layers of limestone concretions, gravel beds, decaying calcareous slates, &c. As all these are very porous, they afford easy channels for the drainage of the surface waters and the materials carried in a comminuted state by the same, and thus surface watercourses are rendered unnecessary. If this process be frequently repeated, as is no doubt the case every year, it follows that the friable, fertile soil around the vents must gradually diminish, and shallow depressions be formed in the course of time, slower or faster, as local circumstances favour. Only one instance remarkable for rapidity of effect can be cited. In a "Bay of Biscay soil" region, on a somewhat steep slope descending from New Mecklenburg plain towards the River North Para, west of Tanunda, a hole was noticed in the ground after a heavy rain; its diameter was about three inches, the depth rather more, the sides steep. A small rill of flood-water escaped into it, without overflowing in the direction of the steep banks of a brooklet some 20 or 30 yards distant. This insignificant vent gradually widened, and in less than two years had augmented to three feet in depth, and over four feet diameter.

The conclusions deduced from the foregoing are:—(1) If the subterranean vents be relatively few, the depressions will be correspondingly apart; (2) the longer the time has been during which operations as described have been carried on, the narrower will be the ridges between the depressions; (3) the more friable the soil the steeper will be the slopes; (4) if the fissures be very small, numerous, and equally distributed, assuming uniform porosity of the subsoil also, none or very shallow depressions will be formed, because every part of the area will be reduced simultaneously at the same rate nearly. Thus the depth and distribution of the depressions depend on inequality of distribution and size of the temporary fissures, the friability of the soil, the porosity of the subsoil, and time.

If the nature of the soil is such as to admit of very rapid expansion, and consequent long detention of the muddy waters, a fine sediment will collect in the bottom, which, *drying hard* when exposed, will at last prevent any deep fissures from forming, and thus constitute what in colonial parlance are termed "claypans"—a blessing for all regions destitute of permanent springs. Some of these are scattered in

the dense mallee scrub between Ardrossan, Yorke Valley, and Kalkabury upon gently inclined flats, and their immediate neighbourhood is at once made manifest by a distinct vegetation, including *Eucalyptus incrassata*, *Callistemon coccineus*, *Juncus pallidus*, and *J. bufonius*, &c., which depend on the greater moisture there obtainable. In a similar manner even lakelets of some extent may be formed anew by the closing or chocking up of the subterranean vents for draining off the rainwater. Thus since about 1852, an almost permanent sheet of water has covered an area of some 120 acres at Hoffnungsthal, near Lyndoch, which had been farmed for several years and produced some splendid crops of wheat. The soil consisted of deep black loam—friable when dry, stiff and adhesive when wet. Under this a yellow arenaceous clay followed, becoming more and more gravelly at increased depths, till at sixteen to twenty feet brackish water stopped further sinking. This basin, inclosed on three sides by high hills of micaceous slates, hornblende schists, quartzites, &c., and at the fourth by a small rising plain, through which at a distance of about a mile a brook flowed, whose bed was at a higher level than that of the basin, had been overgrown with grass and numerous eucalypts, and never observed to contain stagnant water while in its natural state. The drainage received from a considerable area for the locality no doubt then escaped by numerous underground channels, which were choked when the farmers' plough broke the turf and produced more sediment than could be carried along. The first inundation lasted some three months only, when the ground became sufficiently dry for another crop, which grew most luxuriantly, till in the succeeding August it was overwhelmed again by the water in augmented quantity. But only the third year beheld its permanency, the water henceforth being only removed by evaporation. This fact, together with the death of the trees after the first flood, proves the *gradual* closing of the underground outlets (caused by the stirring of the soil), and thereby the correctness of the theory. Some people believed that the opening of the subterranean springs (according to the popular but fallacious idea that tillage, &c., facilitates their increase) was the cause, but this would demand complicated phenomena, the occurrence of which to assume is not warranted in the slightest degree by the surrounding country. It is to be mentioned that out of six or seven wells sunk around the margin only two contained fresh water, the rest so brackish as scarcely to be fit for cattle. The flood water was at first quite fresh, but in the course of years assumed a more and more saline character, and now the whole has the general aspect of an ordinary salt lagoon. The above naturally suggests that this and similar other areas in

great number, containing rich black soil, but vitiated by the accumulation of salts, might frequently be reclaimed under proper scientific guidance (and with small expense considering the value of such lands), but of this our paternal colonial Government is still very impatient, trusting rather to amateurs, who call themselves "practical."

Returning after this digression touching the origin of clay-pans and salt lagoons to the "Bay of Biscay" soil it will be noted that an attempt has been made to show and prove that its peculiar surface configuration is due to denudation, *vertically downwards*, the lateral motion of the waters being retarded or prevented altogether (temporarily, at least) by the nature of the soil; and, it is hoped, this task has been accomplished satisfactorily.

The question now arises, Where and how has this peculiar soil been formed originally? and to which geological period does it appertain?

Replying to this latter question first, for the sake of convenience, this soil seems to belong, in the areas examined at least, chiefly to the Tertiary and Post-Tertiaries, extending to the most recent near the sea-coast.

Whether the former was formed by ice action or atmospheric influences, so much seems sure to an observer of the littoral mudbanks and salt marshes around the head of St. Vincent's Gulf that originally the "Bay of Biscay" soil must have originated in a similar manner and under similar circumstances —that is to say, that in the writer's opinion the present "Bay of Biscay" lands were the mudflats and marshes of former periods. The extensive lowlands around the head of St. Vincent's Gulf, in the neighbourhood of Port Wakefield, the recent marine origin of which is undoubted, afford a good illustration, and may be called growing "Bay of Biscay" lands, the great unevenness of the former being the exaggerated unfinished form of the latter.

Studying localities like the above we find that, while slowly rising above the sea-level, irregular low ridges are formed through exceptionally high tides by deposits of seaweeds, sand, mud, &c., enclosing depressions of various dimensions, frequently retaining part of the flood-waters. When permanently established, these depressions, for some time, gradually are filled up by the dense growth and decay of plants like *Salicornia arbuscula*, the blowing in of sands, dust, weeds, &c., and the inward pressure of the denser ridges. The shells decay, their lime is dissolved and removed by the water, charged with carbonic acid, obtained from decaying vegetable remains. The soil only admitting the downward motion of the water to a certain depth, part of the lime is reprecipitated as tabular or

globular concretions. Augmenting through long period, these layers consolidate to a greater or less extent, and give consistency to the subsoil. When examined, they always show their upper portion to be the hardest and firmest, presenting some openings of variable size at irregular distances, through which the surface drainage alone can escape. These openings, collecting the waters and thereby facilitating the formation of subterranean channels, will be found to be where the percolation of the water is most abundant—*i.e.*, below the depressions; but also elsewhere, if the former be far apart, as other circumstances favour the escape of surface water, and wherever such exist, there in the course of time a hollow will be formed by the gradual removal of part of the soil directly above the place. Thus we come to the same conclusions as those arrived at from a different starting point.

The generally black colour of the soil in these mud-flats is caused by the carbon of decaying organisms and imperfectly oxygenised iron, as proved when exposed to red heat. Both ingredients change simultaneously through the chemical action of the water. The iron taking up more oxygen assumes the characteristic colour, and imparts it to the soil; the carbon is turned into carbonic acid and removed. The latter occurs most rapidly in the depressions. The acidulated water removes a part—or the whole, in small patches—of the iron oxide, redepositing it at lower levels, viz., among buried sands and gravels, cementing them into ferruginous sandstones and conglomerates (assisted, no doubt, by soluble silicates obtained from the same sources), or forming beds or patches of loose lapilli-like concretions with polished exterior surface, sometimes exploding with a tiny crash when thrown in the fire. Operations like the foregoing when acting through long periods may be safely assumed as quite capable to produce all the results in changing the surface aspect of large areas as described, and although one cannot watch them at any one place, yet their respective stages can be observed at different localities. According to this the black portions of the "Bay of Biscay" soil are considered to be due to some unremoved carbon, &c.; the reddish parts to ferric oxide; the light-coloured parts either to the entire absence of either, or the superabundance of lime; both causes render them less suited for vegetable growth till supplied with mould from the neighbouring more productive regions.

If downward denudation be very rapid, as in some parts of the coast plain near Ardrossan, even the greater part of the clay may have disappeared from the ridges, and only some mixed with mould be left in the depressions. In this case the former will be the more barren portions, consisting of small

limestone concretions, sandy clay, &c., and besides obtain less moisture, the water being collected and retained by the hollows. These, therefore, exhibit a denser growth of grass and herbs, and consequently an accumulation of mould.

To account for the different inclinations which the "Bay of Biscay" soil shows, an unequal, but else regular, elevation of the whole area is required; but the various inclines may also have been produced by differential denudation, the latter being more rapidly carried on where the soil operated on was thickest, and thus the valleys scooped out between the hills; on the sides of the hills a part of the soil was left, which originally occupied different levels.

In proof of the theory advanced as to the origin of this peculiar soil, a few observations will be cited. In the neighbourhood of "Bay of Biscay" regions extensive patches of fine white sand are found, generally overgrown by dense scrub; but occasionally holes are found blown out by wind, in which are left all heavier ingredients. Amongst these the writer has sometimes found fragments of large shells. Being 30 to 40 miles from the next sea-shore, their carriage thence by human agency is, at least, very improbable. Whether these sands be assigned to a marine or lacustrine origin is immaterial, as that would not affect the final result. Underlying these sands and the "Bay of Biscay" clays, are frequently found thin layers of ferruginous sandstones and conglomerates, destitute of fossils (except some cavities resembling those left by the removal of large shells or echinids, and some fossilized wood), fringing the respective regions to a great extent, they are found neither to retain the same direction (part denudation), nor the same level (inequality of elevation); never of great vertical thickness, they are penetrated by numerous perpendicular smooth fissures, partly filled with fine oxide of iron and small round holes, through which the rainwater penetrates to the underlying beds. The latter consist of gravels and sand, in some places that were examined; in others of an arenaceous clay strongly impregnated by saline substances, impure salt forming numerous small veins and nests therein. Below these again purplish ferruginous shales of a peculiar wavy structure follow invariably where examined near Nuriootpa, Tanunda, and Greenock.

The latter observations were first made by the writer in 1876-7, and if the saline clays should prove a general feature in connection with the "Bay of Biscay" soil, their discovery would reveal the cause why wells in such regions always produce salt-water. The whole series rests unconformable upon palæozoic rocks of pre-silurian age.

Having first shown, by assuming an originally level surface, that the physical properties of this soil admitted and necessitated

its present surface configuration, through the operation of simple natural causes, and then referred to the forming of the soil as a marine or lacustrine sediment in sheltered and gradually rising localities, and followed the various changes to some extent, with some proofs that the requisite products really do exist where to be expected—it is hoped that the foregoing pages may prove sufficient as a basis (temporary, at least) whereon to ground a more perfect explanation after extended observations by abler minds.

ON SOME NEW CORALS FROM THE AUSTRALIAN TERTIARIES.

By the Rev. J. E. Tenison Woods, F.G.S., F.L.S., President of Lin. Soc., N.S.W.; Hon. Member.

[Read July 6, 1880.]

I propose to describe in this paper three new fossil corals. The first two were sent to me by Professor Tate, and are those referred to by him in his paper on the "Natural History of the Country around the Head of the Great Australian Bight" (Trans. Phil. Soc., Adelaide, 1879), at p. 107, in the following terms:—"Mr. J. Clark, telegraph-master at Eucla, has presented to me a few fossils and stones picked up by him on the surface [of the Bunda Plateau] at Fairlie's last camp, 80 miles N.N.E. from Eucla. The fossils* are undoubtedly older Tertiary, and though their tests are calcedonized and deeply stained with oxide of iron, yet as the matrix is a yellow crystalline limestone, I would refer them to the horizon of the upper bed of the Bunda Cliffs." This deposit he correlates with the upper set of fossiliferous beds of the R. Murray Cliffs, and with the Muddy Creek Miocene strata.

It will be seen from the following remarks that both the species are decidedly tropical in aspect. One belongs to a genus which is only known in the tropics; and whilst the other has representatives in the temperate seas of Australia, yet none of the existing species are of such a large size, and none of the forms peculiar to the temperate seas are in any way similar. These fossils form another link in the chain of evidence as to the semi-tropical character of the fauna of our Tertiary seas. They are certainly to be ranked as amongst the most interesting discoveries made, though the whole of our radiate Tertiary fauna is replete with features of interest and novelty.

In the section of tabular Madreporaria there are four families—two with great development of cœnenchyma (Milleporidæ and Seriatoporidæ) and two with little or none (Favositidæ and Thecidæ). The Milleporidæ have a tabular foliaceous or massive cœnenchyma, and the Seriatoporidæ have the same structure compact; there are four genera in the latter:—

* The species are—*Cerithium Nullarboricum*, Tate; *Plesiastræa*, sp., and *Seriatopora*, sp.

DENDROPORA—Cœnenchyma smooth, calices scattered.

TRACHYPORA—Cœnenchyma vermiculate.

RHABDOPORA—Cœnenchyma finely hispid, calices serial, septa very distinct.

SERIATOPORA—Septa scarcely visible.

The genus *Seriatopora* is thus defined—*Corallum* aborescent; *cœnenchyma* finely hispid; *calices* disposed in an ascending series; *columella* large, compact, and placed in the direction of the axis of the branches; *visceral chambers* obliterated completely in the course of growth.

It is doubtful whether there are ten species in all of this genus, but it is one of the most common on all the barrier reefs of Australia; and probably *Seriatopora subulata* is the most extensively distributed throughout the Pacific and Australian seas. There are no fossil forms known to me, unless those which may occur in the raised beaches on the coast of Java. The discovery of the present fossil (herein described as *Seriatopora antiqua*) in the Australian Tertiaries is a fact of great interest, especially as it has been found in a latitude far outside where any reef-building corals exist now.

Seriatopora antiqua, *spec. nov.*

The fragment is evidently a portion of a broad, compressed, and coalescent branch, resulting from the union of smaller ones, as in *S. subulata*. The branches are hollow. The *cœnenchyma* is very hard and compact, and shows no traces of structure where broken; it is much worn, but here and there exhibits traces of its hispid character in numerous worn granules. *Calices* about one millimetre in diameter, very close, surrounded by a raised ring, rather deep. *Columella* of the form of a large rounded tubercle, much higher than the septa, which are six in number, visible, but not conspicuously so.

The fragment is 25 millimetres long, ten thick, and fifteen wide; but there are also projections like the terminations of branches.

In the size of the calices and the distinctness of the septa, the species resembles *Seriatopora spinosa*, Ehrenberg, which is found in the Red Sea.

Plesiastræa grandis, *spec. nov.*

Corallum a much-worn fragment, about 65 millimetres high, 75 wide, and from 20 to 25 thick. The fragment is broken, so as to expose the plan of the calices and every kind of section. *Corallites* evidently radiating in a convex manner from a central disc; they are long, closely packed, and united by a

very abundant exotheca. *Calices* circular; *septa* in four cycles, three of which are of equal length. There are no calices sufficiently perfect to show the pali; but in section the septa are all much thickened close to the columella, which seems to have been compact. *Endotheca* very abundant, curved upwards from the columella, and showing eight or ten transverse partitions to each of the loculi. *Costæ* continuous with the septa, those belonging to the first cycle being very long, and showing no break at the wall, but passing through it into the septa. Sometimes, though rarely, the costæ are confluent with the costæ of the neighbouring calice, but in this case there is always a thin lamina of epitheca, which forms in section a secondary wall. The internal edges of the septa appear to have been dentate. The endotheca and exotheca are about equally abundant, and the fourth cycle of septa is rudimentary in some of the systems, and very small in all.

Diameter of calices, seven to eight millimetres.

I have already described one fossil species of *Plesiastræa*, *P. St. Vincenti* (Trans. Phil. Soc., Adelaide, 1878, p. 116), but it is much smaller than this species. The genus may be said to be almost an Australian one, and the discovery of two fossil species entitle it still more to this character. The present species is quite tropical in aspect, and would form reefs. It is unusually hard and compact in texture, and, like the fossil previously described, it is very ferruginous, which is not the case with *P. St. Vincenti*. The details are not very satisfactorily seen, but other specimens will doubtless be discovered in the course of time.

Microtrochus minutus, *spec. nov.*; Pl. iv., figs. 3*a*—3*b*.

The third species of coral here to be noticed is a minute fossil adhering to the base of a *Lunulite* from the Miocene beds of Muddy Creek. It probably belongs to the second or epithecated division of Trochosmiliaceæ, but being in a young state not anything very definite about its position can be stated, though I do not think it belongs to any described.

Corallum minute, not a millimetre in height, attached by one side to the base of *Lunulites cupola*, mihi; rather higher than broad. Side with six distinct costæ, which are larger towards the end. About half way up they are concealed by concentric layers of rugose epitheca, through which the costæ are faintly visible. *Calice* nearly circular, uneven at the edge. *Septa* twelve in number, undulating, sparsely spinous, finely granular, with toothed uneven edges. *Columella* represented by three or four twisted processes, which are joined to the septa. *Endotheca* doubtful, but apparently existing between some of the lower septa.

DESCRIPTIONS OF SOME

NEW SPECIES OF SOUTH AUSTRALIAN PULMONIFERA.

By PROFESSOR RALPH TATE, A.L.S., F.G.S., &c., President.

[Read July 6, 1880.]

Ancylus Australicus, *spec. nov.* Plate iv., figs. *4a—4b*.

Shell pale, thin, and delicate; conic depressed, lengthened; sides subrectilinear or slightly convex, diverging slightly forwards. Apex blunt post-median, with about two-fifths the shell behind it, inclining backwards, and directed towards the right; the line from the apex to posterior border slightly concave, to the anterior border almost rectilinear. Peritreme oval, distinctly narrowed posteriorly.

Dimensions of a moderately large example; length, one-sixth of an inch; breadth, one-tenth of an inch; height, one-seventeenth of an inch, the respective dimensions being in the ratio of 100, 60, and 35.

The newly-formed shell is of a pale horn colour, but older parts have a reddish to blackish-brown coloured epidermis. The anterior portion of the cone is ornamented with strong concentric folds.

The *foot* of the animal is translucent, white, and is obtusely rounded behind. The tentacles are translucent, white, triangular, and subcompressed at the base, but are cylindrical in the upper part, ending in a blunt tip. The eyes are black, and in front of and slightly interior to the bases of the tentacles. The muzzle is emarginate, when extended. Only the tips of the tentacles are visible from beneath the shell when the animal is gliding.

Habitat and Station.—This species was first made known to me by Mr. Stirling Smeaton, B.A., who collected one example in a stream at Lyndoch Valley. I have since found it on the under side of the floating leaves of *Triglochin procera* in the Reedbeds; and abundantly in the River Torrens at Adelaide, on the under side of stones and on the submerged leaves of aquatic plants. Mr. Bednall informs me that he collected it in 1876 in the Brownhill and Waterfall Gully Creeks.

Affinities and Differences.—The apex of the shell of *Ancylus Australicus* having a decided inclination to right, the shell is sinistral, and, therefore, belongs to the genus *Ancylus*, and not to *Velletia*. The present species is the first, so far as I am aware, that has been recorded from this continent; though no less than three species have been described from Tasmania. Of these, *A. Cumingianus*, Bourg., has no congener; *A. Tasmanicus*, T. Woods, is separable from our shell by its proportionately greater height, and by its posterior apex; *A. Woodsii*, Johnston, comes much nearer to it. A comparison of specimens of the two species shows that *A. Australicus* differs in the following chief particulars from *A. Woodsii*—It is of a much larger size, is relatively more elevated and broader, and the apex is excentric.

Limnæa subaquatilis, *spec. nov.* Plate iv., figs. 6*a*—6*b*.

Shell thin, fragile, shining horn coloured; ovate subventricose whorls four longitudinally, but faintly wrinkled. Spire short, pointed; suture impressed. Aperture large ovate, half the length of the shell. Columella fold thin, opaque white, and reflected.

Dimensions.—Total length, seven-twentieths of an inch; length of spire, two-twentieths of an inch; length of aperture, five-twentieths of an inch; breadth, three-twentieths of an inch.

Habitat.—Among paludinal herbage growing on the marshy margins of the River Torrens at Adelaide.

This new species is allied to the Tasmanian *L. Huonensis*, T. Woods, but the last whorl is relatively narrower, and in consequence the revolution of the whorls is less oblique. But a species from the same island sent to me by Mr. Petterd, with the manuscript name of *Succinea Johnstoni* comes very near to our shell, if it be not identical with it; however, the Tasmanian specimens, which I have examined, are all young examples, and it becomes difficult to give distinctive characters; nevertheless, in them the spire is more exsert, and the last whorl is slightly flattened at the suture. Mr. Petterd informs me that his *S. Johnstoni* lives among wet moss, a habitat not so dissimilar from that in which *L. subaquatilis* has been found.

Limnæa papyracea, *spec. nov.* Plate iv., figs. 5*a*—5*c*.

Shell oblong ovate, very thin, smooth and shining, pale horn-coloured; wrinkled transversely. Spire rather short, whorls half-rounded at the sutures, last whorl ovate-oblong anteriorly sub-expanded, outer lip sinuously produced about the middle. Columella fold slender, slightly tortuous; inner lip widely and thinly spread. Figs. 5*a* and 5*b* represent a large specimen

selected as a type; figs. 5*c* are those of a varietal form in which the last whorl is more abrupt at the suture and shows a tendency to embrace the spire.

Dimensions of type specimen.—Total length, ·475; length of spire, ·175; breadth, ·275; length of aperture, ·4; greatest breadth, ·2 inch.

Locality.—Numerous dead shells from the bed of a dried up marsh near Penola, South Australia.

Bulimus Myoporinus, *spec. nov.*

Syn. B. sinistrorsus, *Tate*, Trans. Phil. Soc., Adelaide, p. 134, t. 5, fig. 4.

The change in the specific name is necessary because Deshayes described many years ago a New Caledonian shell under the name of *B. sinistrorsus*. The name, here substituted, has reference to the habitat of the snail, that of living under the shelter of *Myoporum parvifolium*.

DESCRIPTION OF A NEW SPECIES OF BELEMNITE FROM THE MESOZOIC STRATA OF CENTRAL AUSTRALIA.

By Professor Ralph Tate, A.L.S., F.G.S., &c., President.

[Read July 6, 1880.]

Belemnites Canhami, *spec. nov.* Plate iv., figs. 2*a*—2*c*.

Guard hastate, terminating in an acute, sub-mucronate, central point; contracted in the medio-alveolar region; compressed ventro-dorsally, the ratio of the two diameters measured at a little further back than at the alveolar apex is as 2 to 3.

Each dorso-lateral face presents, through the whole length of the alveolar region, a deep and sharply cut furrow. In the region of the alveolar apex it makes an abrupt turn on to the medial line of the side of the guard, then splits into two shallow grooves, separated by a uniform distance about equal to their own width, which are continued to the apex.

The *Phragmacone* is sub-oblong in its transverse section, the dorso-ventral diameter is to the other in the proportion of 11 to 13. The *siphuncle* is subinternal, and the axis of the phragmacone is nearly straight.

The *length* of the guard is four inches; the greatest diameter is $\frac{8}{10}$ths, and the corresponding shortest diameter is $\frac{6}{10}$ths of an inch; the axis of the guard is $2\frac{1}{2}$ inches.

EXPLANATION OF FIGURES.

2*a*. Lateral aspect, showing the lateral groove with its flexure and bifurcation.

2*b*. Dorsal aspect, showing lateral furrows.

2*c*. Transverse section of alveolus, showing the unsymmetrical position of the dorso-lateral furrows, and the thin test on the ventral side; *s*, the siphuncle.

Affinities and Remarks.—This Belemnite is related to *B. australis*, Phillips (Quart. Journ. Geol. Soc., London, vol. xxvi., p. 258, t. xvi., figs. 1 and 2), but differs from it in being more distinctly hastate, much more compressed, and in the lateral grooves being continued into a double sulcus. Phillips seems to me to have included two, if not three, species under *B. australis*; and, judging from the remarks of the author and the drawings, the form represented by figs. 3 and 4 cannot be far removed, if separable, from *B. Canhami*. Dr. Hector has, in my opinion, misinterpreted the characters of *B. australis*, when he applies that designation to a species from the cretaceous rocks of New Zealand. (Trans. New Zealand Institute).

The number of specimens of *B. Canhami* examined by me is sixteen; these include examples ranging from $1\frac{1}{2}$ up to 4 inches in length. All exhibit such unmistakable community of characters, which cannot be said of the forms collected under the name of *B. australis*, that I cannot doubt that a good species, distinct from the typical *B. australis* (figs. 1 and 2, op. cit.), is represented by them.

Locality and Horizon.—Mesozoic beds near Peake, Central Australia. Forwarded by Mr. J. Canham, Corr. Memb., to whom the species is dedicated in recognition of his aid in advancing our knowledge of the Natural History of this province. Mr. Chandler, of Peake, writes me "that the specimens you have, were got from the Woodduck Creek, and none have as yet been found in conjunction with fossiliferous rock." The rock here referred to is one yielding *Monotis Barklyi*, *Cytherea Clarkei*, &c.

A second species of Belemnites (incorrectly referred by me to *B. australis*, *vide* Trans. Phil. Soc., p. l., 1879,) occurs in association with the fore-mentioned lamellibranchs at Mount Margaret, as proved by the collections made there by Mr. R. Beetson. The few specimens to hand are too much weathered for specific determination.

THE GEOLOGY OF THE HUNDRED OF MUNNO PARA.

PART II.—THE UPLAND MIOCENE AND FUNDAMENTAL ROCKS AND ECONOMICS.

By GAVIN SCOULAR, Corresponding Member.

[Read August 8, 1880.]

Plates v.—vi.

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1. Introduction and Surface Configuration.
2. Upland Miocene:—Description of Strata; Range; Vegetation upon; Water-bearing properties; Origin; Relation to Auriferous Cements.
3. Fundamental Rocks:—
   Supposed age.
   Geological structure, extent, and surface characteristics.
   Quartzites—description, distribution, and origin of.
   Clay Slate; Metamorphosed limestone.
4. Economics:—Mineral deposits; building materials and road metal. Springs issuing from Fundamental Rocks; Soils and vegetation.

Introductory Remarks.—Having in the former part of this paper carried a description of the geology of the district down to the beginning of the *Drift* period, I will now endeavour to occupy your attention with a description of the older rocks. Following the same plan, I shall in the first place treat of the Miocenes or Upland Tertiaries; afterwards the Fundamental Rocks, and conclude with a short outline of the economic geology and of the soils of the various rocks.

Form of the Ground Occupied by the Older Strata.—A glance at the map and longitudinal section will show that the quartzite series on the east and west occupy high ground, and enclose a longitudinal depression north and south constituted of clay-slate and thin limestones, which have yielded to a larger degree to atmospheric and aqueous action than the quartzites have done. It will further be seen that the direction of the channels of Tenafeat Creek and the South Para River, after receiving the water of that tributary, have been determined pretty much, if not wholly, by the trend and northly termination of the Munno Para quartzites. Though the

drainage of North-Eastern Munno Para, North-Western Para Wirra, and South-Western Barossa, through this numerical reducing and thinning-out to the north of the Munno Para quartzites, finds a comparatively easy outlet to the west. On the other hand, it will be seen that the quartzites intersect the modern watercourses bounding the district on the south-east and south. Thrice had these drainage waters to contend for mastery with the quartzites ere they succeeded in penetrating the stony mass.

I may here state, from the nature and geological structure of the Para and southern Munno Para hills, that in early geological times the drainage of Gould's Creek, Little Para, and adjoining regions was carried off by way of Golden Grove and Modbury, meeting the waters of the then Southern Ocean, probably not far from where the City of Adelaide now stands.

Upland Miocene.

Description of Strata.—These beds attain no great thickness throughout the district, and the bedding may be said to be somewhat indistinct; nevertheless, what still remains, in descending order, can be read as follows:—

The Upland Tertiaries of Munno Para consist chiefly of soft, fine-grained, friable sandstone. The silicious materials frequently held together by an argillo-calcareous paste, not unfrequently impregnated by infiltrations of iron oxides. Though such be the general characteristics of the formation, I have not unfrequently found the basement consisting of one or more of the three following description of beds:—(1.) Angular fragments of quartz and other rocks (which might be termed a *breccia)*, held together by a ferruginous paste. (2.) Though less common, conglomerates, in the true sense of the term, in some cases held together by a cement of argillo-calcareous material; in others, as in the case of the *breccias*, by ferruginous matter. (3.) Most commonly, however, the basement of the deposits consists of mottled argillaceous sand rock, evidently the characteristic sandstone in a high state of decay.

Range of the Formation.—The Upland Miocenes of Munno Para constitute a group of outliers, scattered chiefly over the higher tracts of the district. But these isolated patches are to the geologist of significant meaning, as each of them, when systematically arranged, becomes an integral part of an intelligible language, and though time no doubt has wrought sad havoc in defacing the surface outlines of the country since the period when the deposition of these beds terminated, yet sufficient still remains to indicate that they once overlaid pretty

nearly, if not wholly, the fundamental rocks of the entire area.

On directing attention to the various outliers *in situ*, I shall commence at the south end of the district, pointing out the situations and characteristics of those occupying the higher tracts as we proceed north, afterwards indicating the relation of three patches found *in situ* on the western base of the range.

Beginning, then, on the south, part of Section 4233 is occupied with Upland Tertiaries; from that point northerly these beds continue to overlay the fundamental rocks in part of Sections 4195, 4196, 4232, 4201, and 4230, in which section the superficial area increases considerably, at the same time trending to the east, occupies about one-half of Section 4193, part of 4231, 4862, and about four-fifths of 4863. With exception of the depression or channel of Little Garden Creek, the series passes as a whole into Para Wirra, occupying from 80 to 100 acres in Sections 6381, 6382 in that hundred. I may note, in passing that at the junction of the diagonal roads leading through Section 4363, the watershed of Little Garden and Gould's Creek is situate at an elevation of about 700 feet.

From the lowest point in the south-east corner of Section 4357 the beds continue to occupy the rising ground to the north into Section 4156, where they attain an altitude of something over 890 feet. From this elevation they gradually thin off, until in a small valley from 150 to 200 yards north, the old rocks for a distance of nearly half a mile are completely stripped of their Miocene covering. In this little valley, according to the Railway Survey Department, the elevation is 872 feet. Passing north, in Sections 4676, 3263, 3262, 3266, and 3267, they attain their former development, occupying in the aggregate about 150 acres. In Section 3262, where the cross section accompanying this paper intersects the roadway leading through same, the elevation is 960 feet; from which point, as we approach Yatalunga, a small outlier of the series occurs on the highway at the northern boundaries of Sections 3260 and 3267. From thence the old rocks are entirely stripped of the newer series for a distance of about one and a quarter miles, where a few characteristic fragments are to be seen in Section 4191. And lastly, at an elevation of 978 feet, the Gawler Town hill is capped with Upland Miocene, identical in all respects with the deposits of the same horizon at lower levels. These beds are distributed not only over the higher tracts of the district, but also repose at low elevations on the western slopes of the range. An inlier surrounded by drift occupies the bed of the creek in Section 3328; and two small outliers

occur, one in Section 3087, at an elevation of 340 feet, and the other in Section 3306; both are *in situ*. As further evidence of their general prevalence at a former period, detached fragments of quartz, quartzite, and various other pebbles imbedded in a ferruginous paste, also fragments of the ordinary prevailing Miocene sandstone, all characteristic of the formation, abound in the soils and subsoils throughout the higher tracts of the district. Such detached masses occur notably in Sections 4178, 4148, 4149, 4147, 4160, 3309, and many others. Further proof is afforded by the occurrence of highly water-worn pebbles in the soils at various places, especially in Section 3309, at an elevation of about 550 feet, and though less profusely, most characteristically so in Section 4160. These pebbles are of various sizes and kind, and are evidently the remnants of a Miocene shore line.

Vertical Extent and Stratigraphical Relation to the Primary Rocks.—Because of their great capacity for water, and that in consequence vertical abrasion is reduced to a minimum, no well-defined section is presented throughout the whole area; and though all my measures are merely approximate, yet I think in several places the formation extends to 30 feet. The deepest and best exposure is in Section 3263, where Mr. Philip Butler essayed to open a quarry for the purpose of obtaining stone for the ashlar-work of his mansion erected at Yatalunga 28 years ago. Though the stone at this place rather exceeds the general average, both in colour and quality, yet after penetrating to a depth of ten or twelve feet it was abandoned on account of its exceeding brashy character.

They everywhere rest unconformably over the uptilted edges of the *Palæozoic* or *Eozoic* rocks, and the basement bed of the formation is usually an arenaceous mottled clay, but it is sometimes a breccia or conglomerate; these various characteristics of the bottom beds being overlain by a white silicious sandstone of variable thickness and colour.

Vegetation.—Throughout the actual area, and that covered by waste from the Upland Tertiary beds, the soil is of the most sterile character; consequently vegetation, though represented by a goodly number of indigenous flowering plants, presents for a considerable portion of the year a most barren and dismal aspect. But at spring time these shrubs and herbs, then in blossom, impart a most pleasing effect to the landscape. The grasses are all indifferent fodder plants. Timber of all kinds is also small and dwarfed in size; in short, forming a criterion from the vegetable life as developed over the Munno Para Upland Tertiary outliers, it is well that they have been reduced to their present circumscribed area, otherwise Munno Para

would be now constituting part of an Australian desert, even though its climate is a fair average for South Australia.

Professor Tate has very kindly supplied the subjoined note:—"The following plants are restricted in Munno Para to the Upland Miocene surfaces. Among shrubs and undershrubs—Hybanthus floribundus, Boronia cærulescens, Leptospermum myrsinoides, Calycothrix tetragona, Hibbertia densiflora, H. fasciculata, Grevillea lavandulacea, Hakea rugosa, Banksia marginata, Isopogon ceratophyllus, and Styphelia Sonderi and other epacrids. Of herbaceous plants the following are conspicuous by their profusion and brilliancy of blossom:—Burchardia umbellata, Thelymitra longifolia, Diuris maculata, Prasophyllum fuscum, Caladenia Patersoni, Pterostylis longifolia, and Glossodia major; Drosera auriculata, Euphrasia Brownii."

Water-bearing Properties of the Beds.—No permanent spring of noted consideration issues directly from these beds. Nevertheless, when we consider not only the exceedingly pervious character of the newer rocks, but also the nature of the surrounding debris (a pervious sand, in many instances extending far beyond their present limits in actual *situ*), it is reasonable to infer that they materially add, in an indirect way, to the subterranean water supply which issues forth at lower levels from the fundamental rocks.

A rough approximate of the annual storage of water derived through the direct action of these beds and surrounding detritus may be reckoned as follows:—Superficial extent, 1,400 acres; average rainfall, 22 inches. The usual method of solving such problems, when the upper rock stratum and its superficial covering consist of medium permeative constituents, is to allow two-thirds of the annual rain-water as being carried off in the shape of flood-water and by evaporation. But a personal knowledge of the exceedingly pervious nature of the beds in question and that of their superficial covering leads me to infer that 14¼ inches exceed the actual amount of loss thus sustained. Consequently I estimate the loss at 10 inches. My calulations are embodied in the following table:—

Superficial area, 1,400 acres.		
Annual average rainfall	22 inches.	Total in gallons, 697,466,000
Loss by flood-water, evaporation, &c.	10 inches.	Total in gallons, 317,060,000
Stored in the strata	12 inches.	Total in gallons, 380,406,000
Daily product therefrom		in gallons, 1,042,290
Numbers of persons that might be supplied at the rate of 40 gallons per head a day.	.. ..	26,057

It may be observed that though the Upland Tertiaries of Munno Para present a gloomy and weird aspect in so far as

the vegetable kingdom is concerned, yet their sterility in that respect is wonderfully modified when we consider the great redeeming feature they present, viz., a vast storage of water for summer supply to the adjoining neighbourhood.

Origin. No Fossil Remains as yet Discovered in Munno Para.—The origin of this formation, so widely distributed over the country, is at present one of deep interest to the geologist. In the early days of my geological aspirations I was of opinion that the Upland Tertiaries of Munno Para were of subaerial origin. But since my intimate acquaintance with our esteemed President—my own observations, in the meantime, having also extended beyond the limits of the Munno Para beds—I have relinquished that hypothesis as being one inadequate to meet the requirements of the case. Professor Tate is of opinion (see President's address to the Society, 1878-9, page 59) that the formation is of "fresh water origin," and considers it to be "contemporaneous with the youngest members of the Miocene marine strata." In the absence of further discovery of fossil remains, arguments both for and against these views might be raised. I presume the reasons which led the Professor to that statement were that the formation has hitherto yielded no remains of marine life, and that silicified wood, which is a common representative of lacustrine or fluviatile deposits, has been frequently found associated with it. It might be advanced with equal propriety that because of the wide-spread extent of the formation over hill and dale facing the present seaboard from an elevation at Gawler of something less than 300 feet to that of 1,000 elsewhere, the fresh water deposits could not be going on simultaneously with any member of the marine, unless a natural barrier then existed very near a considerable portion of the present eastern coast-line of Gulf St. Vincent to impound the fresh water from the salt. Having no positive evidence to that effect, I think that the age of the Upland Tertiaries, if they be of fresh water origin, most likely preceded the marine Miocene.

Mr. O. Tepper, of Ardrossan, has probably shed more light on this subject than any other inquirer in the field of South Australian geology (see Proceedings of this Society, 1878-9, "Cliffs and Rocks of Ardrossan, Yorke's Peninsula," by O. Tepper, page 75). By this discovery I regard Mr. Tepper as having so far at least traced a stratigraphical connection between the fossiliferous beds near Muloowurtie Point and the unfossiliferous beds of Tanunda and other inland tracts. Therefore, Mr. Tepper's discoveries only await further corroborative evidence to establish the opinion I have for some time entertained, viz., that the patches of Upland Miocene are merely remnants of marine bottom beds.

From the foregoing it will be noticed my argument favours the theory of marine origin. And although the only fossil hitherto discovered in the Upland Miocene is silicified wood, yet its presence is no proof of a purely lacustrine origin of the deposits, inasmuch as terrestrial vegetation has been frequently found associated with indubitable marine fossils. So far as I know, the Upland Miocenes of Munno Para have not produced a single specimen of silicified wood, though it has been procured from the *debris* of a neighbouring outlier in Para Wirra. Indeed the marine beds at Gawler seem to be the great emporium of these ancient vegetable relics, and from careful observation I am led to conclude these chiefly grew near the spot where they are now found.

Relation to the Auriferous Cements of Barossa and Humbug Scrub.—That the deposition of the Upland Tertiary beds of Munno Para and the auriferous cements of Victoria Hill and other old gold-bearing gravels of Barossa and Humbug Scrubs belong to the same geological period a doubt cannot be entertained. Ascending from Gawler, they can be traced overlying at intervals the rugged surface of the old rocks, until at the Victoria Hill and Lady Alice Mine they attain an altitude of about 950 feet. Indeed their relationship is so easily read and defined in that respect that in cases where altitude coincides deposition may be regarded as having been contemporary.

Why the easterly tracts of the Upland Miocenes have become more auriferous than those in Munno Para may be attributed to a higher state of metamorphism prevailing throughout the fundamental rocks to the east.

Fundamental Rocks.

Supposed Age.—Until the appearance of Mr. Tepper's "Rocks and Cliffs of Ardrossan," the fundamental rocks constituting the Adelaide and Flinders Ranges and other minor groups traversing the southern sea-board of South Australia were considered by the most eminent authorities to be not older than Silurian. Mr. A. R. C. Selwyn, in his report to the South Australian Government of a Geological Tour in this Colony in 1859, in his usual careful way of expression, supports that hypothesis. Basing his conclusions from natural sections of the country, they are:—

That an unconformable series tops the summits of a large number of the highest of the South Australian hills. The higher series he regards as of Devonian age, and in the absence of fossils he concludes that the unconformable subterimposed beds belong to the system next in point of time, viz., the Silurian.

In 1866—"Physical Geology of Victoria," page 16—whilst

treating of the Upper Palæozoic rocks of the sister colony, we find that geologist still further modernising the position of our fundamental rocks. "Whether," he says, "the cupriferous, calcareous, and slaty strata of South Australia are, as I am inclined to believe, members of the same group, is uncertain. If so, they have not yet been recognised in Victoria." Valuable, however, as Mr. Selwyn's geological observations are in other respects to South Australian geology, yet his deductions now require modification in accordance with Mr. Tepper's Peninsula discovery, that of Lower Silurian fossils in beds unconformably overlying the slaty cupriferous group of Selwyn. But until more light is shed abroad on the subject we may designate the group of rock constituting the Adelaide chain and Munno Para hills by the somewhat ambiguous term "Pre-Silurian."

Geological Structure, Extent, and Surface Characteristics.—A glance at the map and cross section will show the geological structure of the Munno Para hills to consist chiefly of clay slate, frequently intercalated with bands of quartzites, and less sparingly of marbles, and occasional veins of pure quartz, principally in small nests and strings throughout the clay slate. The length of the range may be estimated at from 24 to 26 miles, taking its rise on the south, a little to the north of the northern boundary of the City of Adelaide, trending northerly through Yatala, Munno Para—where it attains its highest altitude—losing its characteristic outlines north of the South Para River. The topography of the range is solely due to denusive action, therefore the undulating and fertile table lands of the Munno Para hills owe their outline and fertility to the diversified character of the fundamental rocks out of which they have been fashioned.

Quartzites.

Believing that the quartzite bands have acted a conspicuous part in delineating the topography of Munno Para, I have arranged them as follows, viz., west and east escarpment, and middle or mill series.

Using the cross sectional alignment as a base line, it will be observed that only two of the separate bands of the western escarpment series appear at the surface there. Proceeding south, they are traceable through Sections 4161, 4148, 4147, 4159, and south-western portion of 4160. From that point, for some distance south, both bands (especially the western) become obscured by an easterly extension of the *Drift* formation in the ancient gorge of Smith's Creek. The eastern one is well exposed in a quarry in Section 4164. Strike of quartzite as exposed in quarry 10° west of north; dip 25° easterly; esti-

mated thickness, 70 to 80 feet. The general dip of the strata seems to increase rapidly to the south, for in a gully trending east and west through Section 4166—wherein the eastern quartzite band is exposed in a contorted state—the dip of the clay slate, about 70 yards east of where the quartzite finally plunges beneath the slate, is 40° east. As represented by pl. vi., fig. 1., the rocks here have been powerfully affected by an east and west pressure, and had the quartzites chanced to have been less exposed a casual observer might readily have been led to conclude that the distance represented by the diagram contained at least five quartzite bands, whereas there cannot be more than two. Likewise it will be noticed that if denudation had extended a few more feet in depth the contorted quartzites would have been entirely swept away. South from this point the old rocks extend to the west, and include three additional quartzite bands, which in places—notably so in Sections 3271, 3272, and 3273—have undergone a considerable amount of east and west pressure, the effect of which has produced a bold surface outline toward the Little Para.

A peculiar quartz reef, or dike, first begins to attract attention from the *debris* scattered over the surface on the western side of the eastern band of this series in Section 3091. At the southern boundary of Section 3094, it is fully displayed at the surface; and in a gully in Section 3268, it has attained great proportions, and is somewhat columnar in structure. Its strike at this place is about north-west by west, its dip from 70° to 80° south-west. Beyond this point it is not seen, but about one hundred yards west by south, in Section 3270, a detached portion of the same material, some thousands of tons in weight, is exhibited in regular order poised on a substratum of clay-slate.

Williams' quarries, in Section 3092, are opened in the western bands of this series. A splitting up, or repetition, of one or more of the bands appears to have been effected here, for in the gully where the quarries are situate four bands of quartzite are seen intercalated with the clay-slate in the distance of little over 400 yards.

In the bed of the Little Para River, on the eastern side of Section 4,400, a quartzite band is there seen in horizontal stratification, which phenomenon, in connection with that at Williams' quarries and several others of a similar kind throughout the district, leads me to infer that the various bands (some at least) as exposed at different inclinations in the bed of the river and elsewhere, are repetitions at the surface of the same beds.

Returning to the north of the cross section. The quartzites

as exhibted in a gully leading through Sections 3247, 3306, 3305, and 3304, are, with the exception of one small break in the series, contorted and squeezed together in such a manner as to represent a continuous whole for a distance of at least sixty chains. As will be observed by the map, the western portion of this series of foldings is no longer traceable, because buried beneath drift. The eastern limb, however, can be distinctly traced into a gully about four chains north from the southern boundary of Sections 3302 and 3303, where the foldings, are very distinctly shown. Between this point and the former, a distance of about 32 chains, the average strike is about 10° east; a few chains north of this the strike suddenly veers to the west about 20°, plunging the whole series under the drift shortly after entering the south-west corner of Section 2183, where no sign of folding is visible.

About half a mile south-east of north-west corner of Section 2183 a quartzite band feathers in amongst the clay-slate. Though comparatively thin on its first appearance, it increases in thickness on its way north, and in a gully in Section 3326 it has attained a thickness of at least 100 feet; the dip is here 60° east. For some considerable distance it again thins off. To the north, in a gully in Section 3325, the thickness is not more than 40 feet; the dip also has fallen to about 40°. From this point it veers slightly to the east, and from the effect of an *anticlinal fold*, and also a thickening of the beds—as shown in Sissman's quarry, Section 3325—might be attributed the bold outline of the hill embraced by Sections 3324 and 3325. This quarry of road metal has been excavated in the focus of this anticlinal fold, and the beds are very much fractured, and split into all shapes and sizes; as also the band seems to be much thicker than it was in the gully in Section 3325. This disturbance of the strata has evidently extended north, for in a ravine in Section 3328 the quartzites are not only seen in a very massive state, but also as if repeated more than once; and what is even more interesting, the bands, so massive and numerous here, cannot be traced further. They do not appear even in the bed of the gully leading through Sections 3334 and 3216; but on reaching a ravine leading through the northern side of the latter section, the quartzites are here consecutively intercalated with the clay-slates from the eastern margin of the drift to the eastern boundary of the section. Beyond this gully they are not traceable.

Middle or Mill Series.—This series traverses the district pretty uniformly from south to north. Commencing in Sections 3309 and 4174, where, intersected by the cross section and following their outline south, they continue to follow a pretty uniform course until reaching Sections 5675 and 4170, at

which point the eastern band trends slightly to the east. These bands, more especially the eastern one, have acted a most prominent part in deflecting south the courses of the Little Para and Gould's Creek. After the eastern band intersects the bed of the former stream its outcrop bears considerably west. I am inclined to think that here and for some distance south that the eastern band is represented by the remnant of an anticlinal roll. For, as shown in the map, it splits into two in Section 5671, the eastern branch crossing the bed of the Little Para into Yatala, at the Reserve, a little below Richardson's; the western, sweeping on with the course of the river for a considerable distance, in conjunction with the middle and western bands, constitutes the eastern escarpment of the Munno Para hills.

Returning to the north of the cross section, the eastern member of the series trends somewhat abruptly to the east in Section 4179. Pursuing a somewhat sinuous course, it finally terminates, with those of three eastern series, in Section 3330. The middle and western bands, however, follow a more direct course, intersecting the South Para River in Section 3346. This statement is only fully proven so far as the middle band is concerned. The point where the western band should intersect the river—if it extend to there at all—is much obscured by a surface covering of *wash* from the adjoining slopes, therefore its position, as laid down on the map, for a considerable distance south of the river must be regarded as somewhat ideal.

Dip and Strike of the Mill Series.—In a gully passing through south-east corner of Section 3309, about 18 chains south of cross section, the dip of the western quartzite is 40° east. In the same gully, about 120 feet below the horizon of this band, the dip of the clay-slate is 55° east, the strike 5° east mag. north. Estimated thickness of quartzite, 50 to 60 feet. In the same section, in a gully to the south, the easterly dip of the quartzite band has increased to 5°, thickness about the same. In the same gully, in Section 4173, dip of the slate about 60 feet below eastern band, 45° east, strike 5° east. Slate about 60 feet below middle band in Section 4160 (Smith's Creek), dip 35° east. At the old mill (about 10 chains west) dip of quartzite band the same. In a gully leading through Section 4165 false bedding in the clay-slates is very distinctly represented; and although no accurate bearing of the quartzites could be ascertained, the dip of the surrounding slate is about 48° east, strike, 10° east mag. north. In northern portion of Section 4168, and southern portion of 4165, a remnant of one of these prevailing folds so common throughout the strata of the district is distinctly observable here. Also at junction where

gully leading through Section 4168 intercepts that leading through 4165 another of these folds, I am persuaded, exists there; for not only has the outcrop of the western quartzite band increased to the extent of from 3½ to 4 chains over the surface, but the dip of interbedded slate has decreased very materially also; the actual dip of which, about 50 feet below the western quartzite band, is 31° east, thus showing within a very short distance a lowering of the dip to the extent 17°.

The movements causing the displacement of the original conformity of the strata, if I judge aright, have operated in a line nearly 5° west of mag. north, and east of south, for about one quarter mile south in Section 4168. The same phenomenon presented in the western band at junction of gullies in Section 4165 is repeated in the middle band on the southern side of Section 4168, and, nearly in the same alignment south, the eastern band has either been affected by the same disturbing agency, or that some very decided movement of sea and land intervened during the deposition of the eastern quartzite band; for, as before mentioned, it splits into two in Section 5671, and passes into Yatala in that condition. In middle band at north-west corner of Section 4170, a very fair rough building stone could be procured. On western side of river, southern boundary of Section 1560, dip of the slate 28° east, strike 5° east. As represented in cliff on eastern side of the river in Section 1560, the western member of the eastern band there measures from 50 to 60 feet in thickness. A little further west the middle band is exposed in a fine section in the shape of a miniature waterfall. The western band is not so well exposed either on the north bank or in the bed of the river. However, all three are conspicuously seen in regular order, as they obliquely ascend the bold ascent on the southern side, finally passing in their course to the south, forming a component part of the bone structure of the Para hills.

Remarks, North of Cross Section.—As the eastern band is removed from its associates by an additional amount of clay-slate, it also becomes thicker, and its lower portion, in Sections 4181 and 3322, almost assumes the character of true quartz. Estimated thickness in Section 3322:—Underlying quartzy beds, 20 feet; true quartzites, 30 feet; dip, 40° east; strike, 10° east. This quartzy character disappears as the band passes through Sections 4350, 4353, and 3317, but reappears for a short distance in Section 3316. The outcrop of the western band exhibits a well-defined course through Section 2183, but it is not so with the middle. In its course through the southern portion of Section 2183 the western band has evidently undergone a reversed anticlinal fold in a north and south direction. At this point the band measures fully five chains

over the surface from east to west, and within that space the quartzite beds are found dipping in both directions. Western side dip not ascertained, eastern side dip 35° east, strike 10° east. A few chains north of this point, and about six chains east from the outcrop of the band, seemingly a reef of quartz of milk whiteness steals in amongst the clay-slate, running parallel for a little distance with the strike of the quartzites. At a distance of about one quarter mile we reach the spring (Spring Gully); here the band is split into three sections. Thickness of the western section, about 80 feet; dip, 77° easterly; strike, 10° west; overlying clay-slate, about 40 feet; dip, 75° east; strike, 8° west; quartzite, about 40 feet; dip, 75° east; strike, 8° west; clay-slate, about 80 feet; to the east of which is exposed the largest section of quartzite, representing, from west to east, a surface measurement of four chains, the western side of which is dipping west at an inclination of 65° west, strike on that side of the fold 10° west. On the eastern side of this partially abraded fold the actual dip of the quartzites was not ascertained. Two chains east from their junction with the clay-slate the dip of the latter was found to be 70° east, strike 8° east.

On the north slope of the gully the phenomenon presented at the spring becomes altogether obscured, but in a gully obliquely intersecting northern boundary of Section 2183 the band is again exposed in a connected form, though still exhibiting a somewhat irregular and confused appearance; dip of slate rock on western side 70° east, strike 10° west. It then passes on through Sections 3323, 3324, and 3329, where it becomes entirely covered with slate rock, in which state I believe it passes through Section 3333—marked spring—for in the bed of a small gully near the southern boundary of Section 3336 the round back of an anticlinal roll is seen peeping out under the overlying clay slate. From this point, both the western and middle bands—(nothing of particular interest is connected with the middle band north of cross section)—seem to split up into detached and unreadable sections, as they pass through Section 3335; and in Section 3343, it becomes almost impossible to define the position of their outcrop, and so continue in that obscure state until reaching the south bank and bed of the River Para in Section 3346.

Eastern Escarpment Series.—By the map it will be seen that a distinct series of quartzite bands traverses the eastern side of the uplands of the district. Their general bearing is considerably more west of north than those traversing the western escarpment of the Munno Para Hills. I have thought fit to term the series as above, because, whilst the features of the country were being sculptured by the successive action of

denusive agency, they preserved a somewhat similar bold outline on the east, as the western ones did on the west. It will also be observed that not one member of this series extends so far north as Section 3331 All, with one exception, intersect the bed of the Little Para, and on the south side of the river impart a bolder outline to hill and dale.

A common character prevails throughout the bands of this series. In a ravine in Section 4191, east of Gawler Town Hill, a very fine section of the eatsern band is exposed, presenting a synclinal axis, as represented in diagram I. The rock here is very hard and compact in structure; and also the massive bedding is exceedingly well defined. In consequence of this fold, as abrasion brought each succeeding bed nearer the surface, so at last when denudation has excavated below the axis of the syncline the band has entirely been removed. This takes place at a distance of less than half a mile north from where it is so fully developed. As will be seen by the map a lateral overlap of this band occurs in Section 1645. Whether this severance of the quartzites be due to original deposition or to dislocation of the strata, as yet I have not been able to determine. Dip of this band, at about 200 yards north of cross section, is 70° east.

Eastern Isolated Band.—As shown on the map this band is entirely confined within the limits of Munno Para; its strike bears more west and east than any of the others, and I am inclined to believe that it is only an extensional fold of one or other of the bands to the west of it, from which it has been removed so far in consequence of its low dip, and the depth to which denudation has been carried. On the South Para River it is entirely cut off to the north by abrasive action, the waters of the river having cut a channel into the slate rock nearly 100 feet below the synclinal axis of the quartzite. Throughout the highlands of Sections 3347 and 3348 the western limb of this synclinal curve can be also traced to its termination there by the tortuous outcrop of the quartzites.

A natural section of this band, in a gully a few yards north of the southern boundary of Section 1783, shows a down-throw between two faults. The dip of the adjacent slate is conformable to that that of the quartzites abutting against either fault. At a distance of a few chains east, however, the westerly dip of the slate gradually changes to the east. The faults, which are here about four chains apart, traverse the country in a south-south-east direction, in such a manner that at no great distance south they become connected as one fault, and that at, or soon after, their intersection, stratigraphical discordance is no longer traceable.

If solely guided by geographical demarcation, this band completes the Munno Para series to the east. As it happens in this case the geographer's line of demarcation coincides badly with the geologist's. Consequently, I have extended the cross section rather over one mile into Para Wirra, embracing a limestone band, an extensively developed series of quartzite bands, and thus constituting a geological line of demarcation between the less metamorphosed clay slates of Munno Para, and the mica-schists of Para Wirra.

Origin.—A singular coincidence, one that has not escaped the keen eye of Professor Tate—see his Presidential address for 1879—is that the fundamental rocks when followed easterly in the direction of their prevailing dip become more highly metamorphosed; for it is true that vast accumulations of granite and granitoid rocks, whether of Plutonic or Metamorphic origin, are distributed throughout the old sedimentary rocks constituting the range on the west of the River Murray. That the superabundant heat arising from what we see of these outbursts conveyed direct should have effected the condition of the strata so far west as the western boundary of Para Wirra is very improbable. Nevertheless, I am of opinion that the same fiery energy which produced the granite and granitoid rocks of the Murray Range, effected at the same time the metamorphism of the Para Wirra beds from a deeper seated point. A bed of rock on the surface in Para Wirra, from its natural inclination, as it extends east becomes deeper buried beneath succeeding beds, and also nearer the seat of Plutonic energy. Therefore, the bed which at the surface in Para Wirra represents a mica-slate, in all probability at a moderate depth represents gniess, at a greater granitoid, and at still greater depths, and also proceeding into closer proximity to the superheated mass, a true granite. In this manner, though youngest in the series, the Para Wirra rocks may have been affected by capillary conduction of heat directed through the plane of original bedding, though placed at considerable distance from the scene of actual fiery activity. Another theory might be propounded, which is also the most probable, that the fiery energy that produced the granite and granitoid rocks to the east occupied a deeper-seated horizon in the west as it extended beneath the Para Wirra beds, and thus affected them vertically upwards.

Mr. A. R. C. Selwyn, in his valuable "Geological Notes of South Australia," suggests that some at least, if not all, of our quartzite bands might be looked upon as being metamorphosed Plutonic rocks—a theory which cannot be applied to any of the Munno Parra bands, unless possibly to one of them. A flying excursionist, as Mr. Selwyn was whilst here in official

capacity, dropping across a quartzite band in a highly metamorphosed condition would be very apt to ascribe it to a Plutonic origin, as being the more simple explanation. Having no intention whatever to gainsay the opinion of so able an authority as Mr. Selwyn has proved himself to be in other respects relative to South Australian geology, yet after a careful investigation of any given band for a considerable distance, the invariable conclusion has been favourable to its sedimentary origin. Proof of their sedimentary origin can be adduced as follows:—1. Because of their uniform interstratification with the surrounding clay-slate. 2. Though fractured extensively by lateral pressure they still retain the outlines of original beddings. 3. The quartz grains building up the lesser metamorphosed specimens invariably bear a water-worn appearance. 4. Though not abundant, characteristic water-worn pebbles of a pre-existing quartzite have been found imbedded within them; also, on one occasion I found an enclosed fragment of considerable size of a pre-existing clay-slate.

The foregoing, to my mind at least, fully establish the sedimentary origin of the quartzites, and from the nature of the deposits it is inferred that dry land existed not far away, but in what direction it is scarcely possible to hazard an opinion. This much might be inferred, from the small percentage of embedded pebbles within them, that in whatever direction this ancient land was situate it did not present a bold coastline.

Clay-Slate.

This class of rocks constitutes by far the largest moiety of the fundamental rock system of the district. In some cases the beds are found gradually passing from a fine gritty quartzite to that of the characteristic slate. In others the slates are divided from the quartzites or marbles simply by a flaky parting. Frequently metamorphism (which in no case throughout the district of Munno Para has acted intensely) has most powerfully affected the slates near their junction with the quartzites, quartz reefs, nests, and strings of quartz. Near their junction with the latter, frequently the slate has become chloritised in character, slippery to the touch, and greenish in colour. Where metamorphism has acted moderately, especially where soda and other allied chemicals are present, the slate beds are in a state of rapid decay. Thirty years' observation has led me to believe that in situations where these allied influences are in unison abrasion of the clay-slate is going on at the rate of several inches per century.

Marble, or Metamorphosed Limestone.

In no case have I been able to trace this class of rocks continuously throughout the entire extent of the district. This fact at once leads me to conclude that their deposition was more restricted by local influences than that of the sands now constituting the quartzites. I have invariably found that abrupt depressions of the surface indicate their lines of outcrop. The beds have a tendency to decay pretty uniformly with the intercalated clay-slate, and in the low-lying parts they are covered to a considerable depth with recent *debris*. It is, therefore, only by the aid of these depressions and where they stand out in bolder relief on the ridges, that their outcrops can be traced extensively at all.

Beginning from the west, the first in order of the Munno Para marbles is a compact grey stone, overlying, at a distance of 30 feet, the eastern quartzite band of the Mill series. In Section 4173 it attains no great thickness, and I have not been able to trace it further south than into Section 1678. But by the aid of the above-mentioned surface depressions I have followed the line of outcrop north into Section 4350, where a very good section of the outcrop is exposed, averaging a thickness of from 12 to 20 feet, and further extension in this direction is indicated by the presence of surface blocks of the same kind of stone.

No. 2. A black stone, somewhat slaty in character in places, is situated about 12 chains east of the former. It follows a north and south line into Section 4178; by the help of the surface depressions I have been enabled to follow the line of strike south into Section 4215. The limited exposure of the bed prevents accurate measurement of its thickness being taken, but in Section 4173 it is estimated at from 30 to 40 feet.

No. 3. Intersects cross section in Section 3266. Its position is only inferred by a chain of surface depressions, and a few small blocks strewn over the adjoining surface.

No. 4. Another stratum peeps out, though faintly, in Sections 4146 and 4350.

No. 5. As shown on map, passes through Sections 3347, 3348, and 3349.

No. 6. Still further east another band occurs in Section 1032 and 1033, the strike of which is about parallel to that of the eastern quartzite band. No. 5, in passing south, from about five chains within Section 3348, trends in the same direction.

Also on a spur overlooking the bed of the river, in Section 1787, an impure marble has been detected.

Origin.—The occurrence of limestone suggests the proba-

bility that life existed in the sea in which it was deposited; but as lime must have formed a constituent of the waters of the ocean before life was there to utilise it, and knowing the rocks constituting the Adelaide chain and Munno Para to be much older than the Silurians of Yorke's Peninsula, it is quite possible that the material forming the marbles of our ancient fundamental rocks was collected from the early water by direct chemical agency.

Quartz Reefs.

Except the vast mass referred to at page 114 (if it be a quartz reef), and one peeping out in a gully excavated in the drift in Section 3086, and nests and strings frequently occurring throughout the clay-slate, no other sign of quartz reefs, in the true sense of the term, occurs throughout the rocks on the western side of the watershed.

On the South Para River, however, in Sections 3347 and 3348, a pure white quartz vein is seen trending in a north and south direction, seemingly in conformity with the dip and strike of the surrounding strata. Also another occurs in like conformity with the general stratification in Section 1033. Near this place in the bed of the river, the old alluvial workings are situated, where gold in anything like paying quantities was first discovered in South Australia, in 1850; and these attracted the attention of a few until the advent of the gold mania in Sydney and Victoria. From what I have been able to gather of the nature and character of the gold found here, I am inclined to think it was not derived from the adjoining quartz reef, but had been transported hither from a distance, probably from some extinct outlier of the gold-bearing Miocene gravels of Barossa.

Economic Purposes.

Copper.—Slight indications of this metal have been found staining the nests and strings of quartz distributed throughout the clay slate. However, up to the present time no find has been made of sufficient importance to induce a systematic search.

Iron.—An ore of this metal is indicated as occurring in interstratification in the cross section. I am, nevertheless, not yet quite convinced whether or not it is correctly so placed. Surface indications, however, in Sections 3267 and 4146, and elsewhere over the same line of strike, have induced me strongly to infer that an interstratification of that mineral occurs in the fundamental system near the place shown in section, pl. vi., fig. 2.

Building Material.

Embracing the fundamental rocks, building material, such as it is, is plentiful throughout the eastern tracts of Munno Para. As might be expected the best is obtained from the quartzites, and these (with the exceptionof Williams's Quarry, Section 3092; Billings' Quarry, Section 3094; and Bald's Quarry, Section 3306—none of which could be used for fine ashlar-work) are fit for strong rubble work only.

No attempts have been made to procure building stone from the clay-slate except to the east of Gawler South, and as the stone seems to be less adapted for building purposes than that from Glen Osmond—and even this, to my mind, is deficient in some respects—I cannot recommend its use.

Fundamental Limestone.—No natural sections of these beds are displayed throughout the district; nevertheless, along the line of strike advantageous sites for quarries could be selected, and, in my opinion, an excellent and durable building stone could in many cases be procured.

Travertine.—Very little of this material has been used in Munno Para for building purposes, unless it be for mortar.

Mortar.—The travertines of the Munno Para hills, on account of various impurities, are poorly adapted for building purposes generally. Probably the greatest defect is their including small nodules of fundamental limestone. Unless the greatest care is exercised during the process of slacking, the inclusions remain undissolved, bursting and destroying the work months after its execution.

Sand.—Sand of very fair quality for building and other economic purposes is procurable from dunes of a similar character to those situate in the neighbourhood of Alberton throughout the lower tracts of the district. In the highlands the waste from the Upland Tertiaries furnishes a material for finishing plaster work not surpassed by anything obtained in the colony.

Brick.—In no case, to my knowledge, except at Smithfield—where the works are abandoned—has this auxiliary to the builder been manufactured. Should a demand ever spring up abundance of raw material will be found throughout the redepositions of the drift, along the banks of the Gawler and Little Para Rivers.

Road Metal.

If discriminate selection were exercised by those in power over our macadamised road system, abundance of most durable road metal could be procured throughout the quartzites and fundamental limestones of Munno Para. As already stated, in some of the quartzites the feldspathic paste

is in a high state of decomposition, so that stone of this kind, though containing much silica, is, nevertheless, exceedingly friable; and when such is used for road metal the percentage of argillaceous matter is altogether insufficient to hold together the more indestructible, but incohesive, particles of silica. Roads constructed or repaired with such material always present during our hot and dry summer months a rough and gritty surface, every casual puff of dry wind renewing the grating powers of the rasp.

Fundamental Limestone.—With all due respect to the opinion of the members of our various Road Boards, District Councils, and superintending officers, I am persuaded that they would do well to direct greater attention to this class of material for road-making and mending purposes. Being fully convinced that the metamorphosed limestones of Gawler Hill are 100 per cent. more durable for road purposes than many of the quartzites used, I venture to suggest to those in authority that the marbles should have at least a fair trial.

Travertines.—Except where the traffic is light, or for blinding purpose, those of Munno Para are not adapted for road construction.

Clay-slate.—The harder sorts, when broken to 4 inch gauge, make a very fair foundation for new roads. Also, I am of opinion that a mixture—say of one to six or eight—broken up with quartzite, would tend to bind and prolong the wear of that material greatly, having seen the highly decomposed specimens of that rock used to great benefit in blinding over quartzite metal.

Springs issuing from the Fundamental Rocks.

Probably no like extent in South Australia can boast so goodly a number of surface springs of excellent water as can Munno Para East. To obtain that happy condition the country must necessarily possess the following qualifications:—First, an absorbent super-stratum; second, a moderately retentive sub-stratum. These geological characteristics Munno Para East naturally possess in a marked degree, therefore it behoves the occupants of the soil to see that these natural gifts are not infringed upon.

In a former part I had occasion to direct attention to the exceedingly absorbent properties of the Upland Miocene bed. My object now is to show how the waters directed from the surface by the action of these beds into subterranean channels again re-appear at the surface in the shape of refreshing springs. A glance at the map will show the absorbent, or Miocene, beds, chiefly occupying the higher tracts. Rainwater falling upon this superficial sponge soon penetrates beyond the influence of

active evaporation, and on reaching the up-turned edges of the older beds trickles in at every pore and crevice surcharging the same to great depths. We have thus formed at considerable altitude an internal cistern, as it were, which has only to be tapped, naturally or artificially, at a lower level to obtain an overflow. In this case, to reach the contents of the subterranean reservoir, nature has excavated the deep valleys of Gould's, Little Garden, and Tenafeat Creeks nearly in parallelism with the strike, and on the dip side of the fundamental rocks. These geological features would naturally lead the geologist to conclude that all, or nearly so, of the outflow would be by these channels. It is not so, however; the deep, transverse chasms of Smith's Creek and Spring Gully have effected an outlet direct to the west, by which by far the greatest outflow takes place. Indeed I might almost venture to say that the permanent supply to these creeks is not to be surpassed for the given area by any other in South Australia. On the map I have indicated the sites of the springs, all of which flank the heights overlaid by the Upland Miocene beds.

Soils.

The soils in Munno Para partake much of the character of the beds on which they rest. Therefore, throughout the uplands, the character of the soil might be taken as a pretty sure index to the kind of rock below. Where a stiff clay soil prevails the bed-rock will consist chiefly of clay-slate. When the soil is more friable and loamy, the underlying slate is probably interbedded with a band of fundamental limestone giving a more pulverous character to the soil, and this is in my opinion one of the chief sources of our crust limestone or travertine. This description of soil, though probably not so inexhaustible, is in the virgin state more fertile than those overlying the Drift. The soils formed from the *debris* of the quartzites and Upland Miocenes are generally of a coarse sandy character, and are less enduring than either of the above.

Finally, I beg to direct attention to patches of subsoil occurring in protected spots at high altitudes, which at first sight might readily be mistaken for outliers of the true Drift series. A little investigation of the imbedded material and comparison with that from the natural surroundings, from whence it might reasonably be expected to have been derived, has invariably led me to the conclusion that it is merely the product of a comparatively recent subaerial wash from the adjoining slopes.

Vegetation.

Thirty years ago the prevailing indigenous grasses of Munno

Para were the Speargrass, Kangaroo grass, and a few others now long since extinct. As cultivation progressed, the first to invade these native forms were the Canarygrass and Wild Oat; afterwards the Barleygrass, and lastly the Silvergrass and Cape-weed.

Native Flax, in the early days, was a common plant throughout the lower tracts, and the common Grass-tree also found a favourite station on some of the soils derived from the waste of the quartzite bands.

In the arboreous class much greater diversification prevailed. The characteristic trees inhabiting the quartzite soils were the Sheaoak, Poison-berry tree, an occasional Native Cherry-tree, Wattle *(Acacia pycnantha)*, and Peppermint. As the situation approached the higher altitudes and partially occupied by the Upland Miocene, the latter give place to varieties of the Blue Gum and White Gum. The alluvial flats of Gould's, Little Garden, and Tenafeat Creeks and their tributaries, and the sources of Smith's Creek, were the favourite stations of the Red Gum, in some cases sustaining those trees to wonderful sizes.

Soils derived from and immediately overlying the clay-slate and marbles, for the greater part produce Wattles, chiefly the black variety, which are indigenous to the soils of the Drift also.

The arboreous plants originally inhabiting the lower tracts (Peachy Belt) were large Peppermint, Mallee, Pine, Native Peach, and a vast variety of shrubs, which have all, or nearly all, become extinct since the advent of modern husbandry,

Conclusion.—If these lines—I don't flatter myself they are faultless—tend to create a greater interest in the minds of our inhabitants towards the development of South Australian geology, I have attained the chief object that prompted me to devote many a spare hour in collecting the ground-work upon which the remarks are based, fully intending to extend the sectional line across the Schist formations of the Barossa Ranges to the newer Miocene beds of the Murray Plateau.

Having so far completed—though I am afraid imperfectly—a self-imposed task, it now devolves upon me to acknowledge my indebtedness to those I have found ready to assist in my labours in the field, especially to Mr. John Alexander, Mr. Alexander Adams, Mr. Robert Paterson, and pre-eminently to Professor Tate, of the Adelaide University. To the last named gentleman I am not only indebted in an especial manner for his labours and valuable practical suggestions in the field, but also for arranging the subject matter of the foregoing lines into greater conformity with scientific requirements.

EXPLANATION TO PLATES.

Plate V. Geological map of the eastern half of the Hundred of Munno Para. Scale, one inch to a mile.

Plate VI. Fig. 1. Diagrammatic section of about twenty chains in gully passing through Sections 4,166 and 4.155.

Fig. 2. Horizontal Section from Railway Station at Smithfield, bearing E. 14° S. into the Hundred of Para Wirra. Datum line, 160 feet above low-water mark. Horizontal scale, three inches to one mile; vertical scale, quarter-inch to 100 feet.

PLANTS INDIGENOUS TO THE NEIGHBOURHOOD OF HERMANNSBURG,

ON THE RIVER FINKE, CENTRAL AUSTRALIA.

By the Rev. J. KEMPE, Missionary.

[Communicated by Baron F. von Mueller, K.C.M.G., F.R.S., &c., Hon. Memb.]

[Read October 5, 1880.]

Introductory Note by Baron F. von Mueller.—I had named the species of the following list of plants from Mr. Kempe's successive collections. As a constituted whole it gives a good idea of the vegetation of the mission locality. Next year a second list will be given. Mr. Kempe writes—"If rain should fall in summer, then nearly all species of flowering plants, even most of the shrubs, commence to blossom a second time. The maximum temperature is in the shade 120° F., and the minimum is 27° F."

DICOTYLEDONOUS PLANTS.

CRUCIFERÆ.

Lepidium papillosum, F. M.; *L. phlebopetalum*, F. M.; *L. ruderale*, Linné. All annuals, widely dispersed over the whole country, and blooming in August.

Stenopetalum nutans, *F. M.*; an annual.

Erysimum lasiocarpum, *F. M.*; an annual, growing in shady places only, particularly under shrubs; flowers in August.

CAPPARIDEÆ.

Capparis spinosa, Linné and *C. Mitchelli*, Lindley; both perennial shrubs. The latter attains to a height of 10 to 12 feet, whilst *C. spinosa*, the true caper-plant, is a somewhat trailing shrub, growing up and near the ranges, even on the most arid and deserted places. The month of November is the usual time of blooming, but *C. spinosa* is blooming and bearing fruit nearly all the year, even in winter.

Cleome viscosa, Linné, is annual, which grows only on stony places.

VIOLACEÆ.

Hybanthus aurantiacus, F. M. A low perennial, growing mostly on calcareous soils, even on barren limestone hills; it flowers nearly the whole summer.

STERCULIACEÆ.

Melhania incana, Heyne; a small shrub, widely dispersed.

Commersonia sp., grows on the sandhills, where it keeps green all the year.

Waltheria indica, Linné. This low perennial is confined to the Glen of Palms.

MALVACEÆ.

Hibiscus microlænus, F. M. A shrub attaining the height of four to six feet. It grows on the most arid places on the hills, and blooms, with yellow flowers, nearly the whole summer.

Gossypium Sturtii, F. M. Grows mostly everywhere in the sandhills.

Abutilon Fraseri, Hooker. This plant is growing almost anywhere, whilst

A. tubulosum, Hooker, is only to be found here in the ranges.

Sida corrugata, Lindl. A perennial widely spread over the country.

Malvastrum spicatum, A. Gray. This annual grows also everywhere, but best on calcareous soil among and under the shade of larger shrubs.

Lavatera plebeja, Sims. An annual which attains the height of six to eight feet. It grows only in the river-beds and in swampy ground.

EUPHORBIACEÆ.

Adriana tomentosa, Gaudichaud. Perennial, and growing mostly in the river-beds and near all creeks.

Phyllanthus rhytidospermus, F. M. Annual, growing only in shady places in the ranges.

Euphorbia Drummondi, Bois, and *E. eremophila*, Cunn., are annuals spread all over the country around here.

URTICACEÆ.

Parietaria debilis, Forst.; an annual growing in the ranges.

SAPINDACEÆ.

Atalaya hemiglauca, F. M. This plant grows here only in the ranges, even on bare rocks.

Dodonæa viscosa, Linné, and *D. lanceolata*, F. M., are shrubs, flowering in August. The former flourishes the most on sandy soils, whilst the latter grows only within or near the ranges.

TILIACEÆ.

Corchorus sidoides, F. M. A small perennial shrub, flourishing best on calcareous soils.

GERANIACEÆ.

Erodium cygnorum, Nees. An annual growing only in shady places within the ranges; flowers can be seen all the summer.

Oxalis corniculata, Linné. This annual grows only after rains in the beds of creeks.

ZYGOPHYLLEÆ.

Zygophyllum apiculatum, F. M.; *Z. ammophilum*, F. M.; *Z. fructiculosum*, Cand. The two first are annuals, and, here, the first messengers of the coming spring. The three are disposed all over the country around here, and will grow on the driest sandy soil.

PHYTOLACCACEÆ.

Gyrostemon ramulosus, Desf. A shrub growing on limestone hills, and in general on stony ground.

Codonocarpus cotinifolius, F. M. A tree attaining the height of 20 to 30 feet; it seems to prefer the most deserted places, as it is only to be found either on sandhills or on rocky ground.

CARYOPHYLLEÆ.

Polycarpæa corymbosa, Lam. An annual growing on stony ground.

PORTULACCÆ.

Claytonia Balonnensis, Lindl., and *C. corrigiolacca*, F. M., are annuals, and grow almost everywhere here, provided the soil is not too dry.

AMARANTACEÆ.

Euxolus Mitchelli, F. M., an annual growing on stony tracts.

Ptilotus nobilis, F. M. This annual is only growing here on rich soil in the ranges; whilst

P. obovatus, F. M., and *P. helipteroides*, F. M., can be seen almost everywhere, particularly on sandy plains.

Alternanthera triandra, Lamarck.

CHENOPODIACEÆ.

Rhagodia spinescens, R. Brown. A shrub growing only in shady places, particularly among dense bush.

Chenopodium carinatum, R. Br. An annual spread all over the country.

Dysphania plantaginella, F. M. An annual; it grows only in rich and moist soil, particularly in swampy places.

Enchylæna tomentosa, R. Br., is widely dispersed.
Chenoloa diacantha, F. M. A small annual growing on stony ground; sheep feed well upon it.
C. paradoxa F. M., grows almost everywhere.
Kochia villosa, Lindl., grows mostly on calcareous soils; whilst
K. eriantha, F. M., can be seen everywhere. Sheep feed well on both species.
Salsola Kali, Linné. An annual which attains an enormous size.

NYCTAGINEÆ.

Boerhaavia diffusa, Linné. Grows here only in the Glen of Palms, and is perennial.

LEGUMINOSÆ.

Brachysema Chamberst, F. M. A perennial; it grows here only on the sandhill on Rudall's Creek. The natives eat the flowers of it.
Isotropis atropurpurea, F. M. Annual growing everywhere.
I. Wheeleri, F. M. Perennial, growing on sandy soil in general, mostly on sandhills.
Crotalaria Cunninghami, R. Br. Growing even on the most arid tracts.
C. medicaginea, Willd. Grows only on rich soil; whilst
C. dissitiflora, Benth., will grow even on the white sand of the creeks.
Lotus australis, Seringe. Annual, and growing mostly on sandy soils.
Psoralea patens, Lindl. Perennial, and spread all over the country.
Indigofera linifolia, Retzius. Annual, growing only in rich loamy ground.
I. viscosa, Lam., and *I. enneaphylla*, Linné, are both annuals of rich clayey soil.
I. brevidens, Bentham. A shrub, growing here only in the ranges.
Tephrosia purpurea, Pers., on stony ground.
Rhynchosia minima, De Cand., is a creeping perennial growing in stony places.
Glycine clandestina, Wendl. Perennial, grows on sandhills.
Cassia pleurocarpa, F. M. A shrub, grows on sandy soil.
C. sophera, Linné, is an annual flourishing best in river beds.
C. glutinosa, Cand. A shrub growing on rocky tracts.
C. desolata, F. M.
C. artemisioides, Gaudich.
C. eremophila, Cunn.
} All shrubs, growing in all deserted places.
Petalostylis labicheoides, R. Br., a little shrub growing on limestone hills and the ranges.

Acacias, all phyllodineous, are here in a vast number of species, but their names shall follow next year.

HALORAGEÆ.

Haloragis Gossei, F. M. An annual, growing all about.

MYRTACEÆ.

Calycothrix longifolia, F. M.

Melaleuca glomerata, F. M.; *M. parviflora*, Lindl. Shrubs growing almost everywhere.

Eucalyptus pachyphylla, F. M.; *E. gamophylla*, F. M.; and *E. oleosa*, F. M.

PROTEACEÆ.

Grevillea Sturtii, R. Br., in the ranges; *G. angulata*, R. Br.

Hakea lorea, R. Br.; Glen of Palms. *H. leucoptera*, on loamy plains. Several other kinds of Protaceous plants exist here.

THYMELEÆ.

Pimelea trichostachya, Lindl. A small perennial growing on stony rises.

SANTALACEÆ.

Santalum lanceolatum, R. Br.

UMBELLIFERÆ.

Didiscus glaucifolius, F. M. } Both annuals, growing here only
Daucus brachiatus, Sieb. } on rich but loose soil.

RUBIACEÆ.

Canthium latifolium, F. M. A tall shrub, growing on stony ground, particularly in the ranges. Its sweet berries are the favourite eating of the natives here.

COMPOSITÆ.

Of this order a vast number of species exist here; some only are given. Several are good for sheep as well as for cattle and horses.

Aster subspicatus, F. M., and *A. Ferresi*, F. M., are not restricted to any particular tract.

Vittadinia australis, Rich., grows on sandy soil.

Podocoma cuneifolia, R. Br. An annual growing on limestone hills only.

Calotis lappulacea, Benth.; *C. hispidula*, F.M. Annuals, on sandy soils.

Pterocaulon Billardieri, F. M. A perennial, flourishing mostly on limestone hills.

Pluchea Eyrea, F. M. Annual, widely dispersed here.

Pterigeron microglossus, Benth. Perennial, growing on sandy tracts. It has very lovely flowers.

Wedelia sp. A perennial shrub growing in the ranges and stony places in general.

Glossogyne tenuifolia, Cass. Annual, on sandy soil.

Angianthus sp. An annual, growing only in swampy places.

Rutidosis helichrysoides, De Cand. An annual flourishing mostly on limestone hills. It is spreading rapidly.

Ixiolæna tomentosa, Sond. and F. M. A perennial, growing everywhere.

Podolepis canescens, Cunn. A small annual, growing only on sandhills.

Helichrysum Cassinianum, Gaud. Annual, growing the most luxuriantly amongst dense mulga-shrubs.

H. Lawrencella, F. M.; an annual, in shady and moist places.

H. lucidum, Henckel. Annual, spread over the whole country, but the lovely flowers develop their beauty only in the most deserted tracts.

H. apiculatum, Cand. Annual or biennial, growing anywhere. Horses are extremely fond of it.

H. Thomsoni, F. M.; an annual growing only in shady places in the ranges.

Helipterum floribundum, Cand. Annual; rich loamy plains are after rains quite covered with its flowers.

H. stipitatum, F. M.; this annual plant with its lovely flowers exists here only in the sandhills.

H. incanum, Cand. Perennial, growing on stony, even very arid ground.

H. Tietkensi, F. M.; this annual is growing almost everywhere.

Gnaphalium luteo-album, Linné. An annual growing in or near creeks.

Erechthites picridioides, Turcz. An annual, in moist sand of the river beds, flowering nearly the whole summer.

Senecio Gregorii, F. M.; an annual, blooming early in spring, and growing everywhere, even on poor sandy soil; whilst

S. magnificus, F. M., grows only on limestone hills.

Campanulaceæ.

Isotoma petræa, F. M.; an annual, on rocks; very poisonous, but avoided by stock.

Wahlenbergia gracilis, De Cand. An annual, growing very densely on the plains. There are two varieties here, one with large flowers, and the other with very small ones.

Goodenoviaceæ.

Leschenaultia divaricata, F. M.; an annual, dispersed all over the country.

Velleia connata, F.M.; an annual, on limestone hills; it possesses a tonic bitterness.
Goodenia Rameli, F. M.; on the ranges; whilst
G. Mueckeana, F. M., is only to be found on sandhills.
Scævola parvifolia, F. M.; an evergreen perennial, growing in all deserted places.
Brunonia australis, Smith. An annual, in sandy regions.

GENTIANEÆ.

Erythræa australis, Br. Annual, grows in the sand of the river beds; a good tonic herb, not touched by pastoral animals.

PRIMULACEÆ

Samolus repens, Pers. Growing generally near the water.

JASMINEÆ.

Jasminum lineare, R. Br. A shrubby plant.
J. calcareum, F. M.; also perennial, and growing in the ranges.

APOCYNEÆ.

Carissa Brownii, F. M., var. *angustifolia*, is confined to the Glen of Palms. The flowers are white, and appear in June; the leaves are of a lively green.

ASCLEPIADEÆ.

Sarcostemma australe, R. Br.
Cynanchum floribundum, R. Br. In sand of the creeks.

SOLANACEÆ.

Solanum esuriale, Lindl. Perennial, on sandy soil.
S. Sturtii. A shrub six to eight feet high in the ranges.
S. ellipticum, Br. Herbaceous, growing on rich clayey soil, and also in the ranges.
Nicotiana suaveolens, Lehm., (Native tobacco), grows in the moist sand of river beds, and attains an enormous size.

SCROPHULARIACEÆ.

Stemodia Morgania, F. M.; spread all over the country.

ACANTHACEÆ.

Justicia procumbens, L. A small shrub, growing everywhere, especially in limestone country.
J. Kempeana, F. M.; a dwarf perennial.

BIGNONIACEÆ.

Tecoma australis, Br. A somewhat creeping shrub, growing in the ranges.

CONVOLVULACEÆ.

Breweria rosea, F. M. A perennial, blooming in August, flowers violet, of great beauty.

Evolvulus linifolius, L. A small annual, growing in the ranges.

BORAGINACEÆ.

Heliotropium curassavicum, L., and *H. asperrimum*, Br. Annuals, growing on stony ground.

Halgania cyanea, Lindl. Perennial, grows on the top of the ranges, as well as on sandhills.

Trichodesma Zeylanicum, Br. A tall annual, growing mostly on stony ground, and blooming nearly all the year. The delight of the dromedaries.

Cynoglossum Drummondi, Benth. Annual, growing everywhere.

LABIATÆ.

Prostanthera striatiflora, F. M. A shrub growing on rich plains.

P. Baxteri, Cunn. A variety of this grows in shady places only in the ranges. It is a shrub six to eight feet high, with white flowers, and very small leaves of a whitish hue.

VERBENACEÆ.

Dicrastyles Lewellini, F. M. A perennial of very dense growth, flowers blue, leaves of a whitish hue; it is widely spread in the sandhills.

MYOPORINÆ.

Eremophila Macdonnelli, F. M. A trailing shrub; it grows everywhere.

The following are all shrubs, not restricted in habitat, growing nearly everywhere, but mostly in the ranges :—

E. Willsii, F. M.; *E. Brownii*, F. M.; *E. Sturtii*, Br.; *E. Latrobei*, F. M.; and *E. Freelingi*, F. M.

CASUARINEÆ.

Casuarina Decaisneana, F. M., on sandhills.

CYCADEÆ.

Encephalartos Macdonnelli, F. M., in the ranges.

CONIFERÆ.

Callitris verrucosa, R. Br., only in the ranges.

MONOCOTYLEDONOUS PLANTS.

PALMÆ.

Livistona Mariæ, F. M. Along the Finke River and some of its small tributaries.

JUNCACEÆ.

Xerotes leucocephala, R. Br.

GRAMINEÆ.

Andropogon sp., perennial confined to the ranges.
Pappophorum commune, F. M., annual, only in the ranges.
Festuca irritans (the Spinifex of colonists); is the real plague of the country; it grows everywhere.

ACOTYLEDONOUS PLANTS.

FILICES.

Cheilanthes vellea, F. M., perennial, growing on rocks only.

DIAGNOSES OF

NEW SPECIES OF PLANTS DISCOVERED IN SOUTH AUSTRALIA.

Translated and communicated by STIRLING SMEATON, B.A., Associate.

[Read October 5, 1880.]

Justicia Kempeana. F. v. M., Fragmenta Phytographiæ Australiæ, vol. xi., p. 101. (Ord. Acanthaceæ).

Very thinly pubescent, herbaceous, *leaves small, circular or obovate and wedge-shaped, crenately dentate*, or almost entire; *flowers axillary solitary*, or more rarely almost sessile in twos and threes; bracts herbaceous, leaf-like; calyx five-cleft, below narrow-lanceolate, above lineas-subulate, the lips of the projecting corolla about double the calyx and equal to its own tube; the lower lip shortly trifid; the stamens projecting from the throat of the corolla, one cell of the anthers shortly spurred, the style and ovary smooth; capsule much stipitate; seeds warty and rough.

Near the MacDonnell Range—Rev. H. Kempe. In the neighbourhood of the Ashburton River and between the Gascoyne and Murchison Rivers—E. Giles.

A perennial herb, one foot and a half high, or shorter. Branches thickly covered with appressed hairs. Leaves shortly petiolate, oblong, and wedge-shaped; upper ones

sometimes narrow lanceolate, three to six lines long, and occasionally nine lines. Two opposite bracts one and a-half to three lines long (in the narrow-leaved variety longer and linear-lanceolate). Calyx about one quarter inch long. Corolla rose-tinted; upper lip almost semi-ovate, very shortly and bluntly two-toothed, or nearly entire; the lobes of the lower lip bluntly rounded, the middle one broadest; the tube with the lower lip slightly crested in two longitudinal folds, below, the cresting doubly barbed, from which arise small folds ascending to the upper lip, indicating possibly two suppressed stamens; the middle lobe of the lower lip outside in the bud; the upper lip inside before unfolding; æstivation imbricate, not contorted. Stamens two, with smooth slender filaments slightly thickened above. Anthers smooth, coherent for a time; the free lobe oblique and somewhat the higher, the spur of the lower lobe pale and nearly membraneous, narrow, and almost acute. Style hairlike, smooth, nearly half an inch long. Stigma very small, semi-ovate. Disc cup-shaped, sinuate-dentate. Ovary four-celled; gemmules both superior. Capsule five to six lines long; the seedless base a little shorter than the hollows of the cells. Seeds brown, round, a little more than one line across, with flattened prickly rugosities, half surrounded by an acute retinaculum.

From the neighbouring species of *Justicia hygrophila* it is chiefly separated by its shorter and almost shrubby stem, greater hairiness, smaller leaves (often toothed), leafy bracts, the often solitary flowers, corollas more evidently hairy on the outside, and (as to the variety with narrow bracts) the longer stalked capsule; and, finally, the seeds more warty than granulated with the thickened edge.

Flowers in August and September, and prefers a limy soil.

Schœnus Tepperi. F. v. M.; loc. cit., p. 106. (Ord. Cyperaceæ).

Very dwarf, stem very short, one-spiked, much exceeded by the very narrow-chanelled leaves; lowest bracts produced into a long narrow leafy appendage; the other bracts few, membranous, with a rather wide margin; *a single fertile flower;* no hypogynous bristles; seed vessel three-cornered, obovate, pale in colour, striated longitudinally with three narrow folds.

Yorke's Peninsula—Otto Tepper.

Plant forms tufts. Leaves for the most part from one to one and a-half inches in length, barely one-third line in width, beardless, a little rough at the edge. The flowerless part of the stem scarcely equal in length to the peduncular spikelet. Bracts besides the leafy point two and three lines long; the upper ones narrow but rather obtuse. Stem hollowed out or

curved for the reception of the solitary fruit. Stamens unseen as yet by me. Style two to three lines long, thin and bristle-like. Stigmas three, hairy, a little shorter than the style. Seed vessel two-thirds of a line long.

This species approaches *Schœnus trachycarpus*, but differs from it in its extraordinary dwarfness, shortened peduncle, shorter bracts below the involucre, longer and more membraneous floral bracts, less wrinkled fruit, and no more than a single fertile flower, in which last characteristic it differs from all its congeners hitherto known.

Battarrea Muelleri. Kalchbr. (M.S.); F. v. M., loc. cit., p. 106. (Fungi).

Whitish; inner peridium campanulo-mitrate; *stalk* solid, *very long, chaffy, and scaly*, thickened by degrees above; the chaff-like scales linear lanceolate directed downwards, almost imbricate; spores globose, warty, of a rusty colour, with short filaments, almost spiral, placed between the spores.

In the neighbourhood of Spencer's Gulf—O. Tepper.

A noteworthy species of a remarkable genus.

Stem nine or ten times longer than the breadth of the cap. External peridium hitherto unknown. Spores ·004mm. across.

On the Australian Tertiary Palliobranchs.

By Professor Ralph Tate, F.G.S., &c., President.

Plates VII.—XI.

[Read October 5th, 1880.]

Bibliography.—Among the fossils collected by Captain Sturt during his journey down the River Murray, and figured in his work "Two Expeditions into the Interior of South Australia," 1834, is one terebratulid. The shell has been described and variously named by subsequent authors, and is referred to in this paper as *Waldheimia Garibaldiana*, Davidson. Mr. G. B. Sowerby, in Count Strzelecki's "Physical Description of New South Wales and Van Diemen's Land," 1845, describes and figures a second palliobranch as *Terebratula compta*, which I have removed to the genus *Magasella*. In 1862 Mr. Davidson described Sturt's terebratulid in the "Geologist," vol. v., under the name of *Waldheimia Garibaldiana*, at that time believing it to be from the Tertiary beds of Malta. In the same year appeared the Rev. J. E. Tenison Woods' "Geological Observations in South Australia," in which Sturt's terebratula is confounded with *T. compta*, Sow.; but in the "Trans. Phil. Soc., Adelaide," for 1865, he figures and describes it as a new species under the name of *Waldheimia imbricata*. In the same paper Mr. Woods describes *Waldheimia gigas*, *W. Crouchii*, and shows that *Terebratula compta* belongs to *Terebratella*, in which genus he describes a second species as *T. Tenisoni*. Additional species are made known by Mr. R. Etheridge, jun., in a paper entitled 'On some Species of Terebratulina, Waldheimia, and Terebratella from Mount Gambier and the Murray River Cliffs." (Annals and Mag. of Nat. Hist., 1876). Of the five species herein described and figured:—*Waldheimia Gambierensis*, which is identical with *W. grandis*, Woods, and *W. Garibaldiana*, were previously known; a *Terebratella* is erroneously referred to *T. compta*, it is a species closely allied to the recent *Magasella Cumingiana*, I have named it *M. Woodsiana*. The remaining two species, *Waldheimia Taylori* and *Terebratulina Davidsoni*, are decidedly new.

The Rev. J. E. Tenison Woods describes and figures (Trans. Roy. Soc., N.S.W., 1878) some palliobranchs from the Miocene

beds at Table Cape, Tasmania, collected by Mr. R. M. Johnston. Unfortunately the species are very inadequately illustrated; and also because of the very brief characters given, it is almost impossible to understand the species. However, I have been favoured by Mr. Johnston with the loan of the very excellent drawings of the original specimens, and of some specimens named from the types. The species represented are, so far as I can judge, *Waldheimia Garibaldiana*, and the previously undescribed *Terebratula vitreoides*, *Waldheimia Tateana*, and a species erroneously referred to *W. Corioensis*, McCoy. The last may be a *Terebratella;* it is unknown to me. An undescribed *Rhynchonella* is also referred to in the text. Professor McCoy, in the "Fifth Decade of the Palæontology of Victoria," 1877, figures and describes a new and remarkable *Waldheimia* as *W. Corioensis*, and adult forms of *W. Garibaldiana* under the name of *W. macropora*.

From these sources nine species have been well established, and the existence of three or four others are indicated. Adding to these the species now described for the first time, the total number of palliobranchs from the Australian Tertiaries is 33, generically distributed as follows:—Terebratula, 4; Waldheimia, 15; Terebratulina, 4; Terebratella, 4; Magasella, 4; Thecidium, 1; and Rhynchonella, 1.

Localities and Horizons.—The surpassing richness in palliobranchs of most fossiliferous localities in South Australia is imperfectly indicated by the fact that all the above species, excepting *Terebratella Woodsii* and *Thecidium australe*, have been collected within the province. My experience as a collector beyond the limits of the colony is limited to the Muddy Creek beds, near Hamilton, Victoria. In many of the sections the profusion of palliobranchs and echinoderms recalls a feature of the Jurassic formations. Their generally good state of preservation, and the comparative facility with which the interiors can be dissected out, have enabled me to discriminate species with a much greater degree of confidence than is usually possible. Indeed, no criterion as to generic position can be drawn from the external characters alone. Thus, without a knowledge of the interior of *Terebratula Aldingæ*, that shell might very well have been referred to *Waldheimia*, if not indeed associated with *W. insolita*. Again, the external characters by which *Terebratella furculifera* is separable from *W. insolita* are so trivial in themselves, though nevertheless practical tests, that one might well hesitate to regard them of specific value. In consequence of a mimetic resemblance among some species in different genera, I have hesitated to assign to its genus any species whose interior characters have not been ascertained. In such cases of

uncertainty the generic name employed has a note of interrogation affixed.

The uppermost set of marine fossiliferous beds of the South Australian Tertiaries is almost devoid of palliobranchs; and only in one locality—near Morgan, on the River Murray—have specimens been gathered in a sufficiently good state of preservation for accurate determination. The superior beds of the River Murray cliffs, or Upper Murravian, I have elsewhere endeavoured to prove are contemporaneous with the celebrated fossiliferous strata of Muddy Creek, in Victoria. In both of of them the palliobranchs are all of small size, and are for the most part dwarfed examples of species which have passed up from lower horizons. The species in common are *Waldheimia Garibaldiana*, *W. Tateana*, and *Terebratulina Scoulari*, all rare and small. The Muddy Creek beds have yielded in addition—*Terebratulina Davidsoni*, very rare and small; *Magasella Woodsiana*, small form, though not rare; *Rhynchonella squamosa*, very rare; *Thecidium australe* and *Waldheimia Coriocnsis*, rare. In the basal beds of the Upper Murravian, about Blanchetown, a large *Waldheimia (W. MacLeani)* is profusely abundant.

The Middle Murravian beds contain *Terebratulina Scoulari*, *Waldheimia gigas*, and *W. Garibaldiana* in great abundance.

The Lower Murravian beds of the northern section of the Lower Murray cliffs have not yielded any examples of the class, except *Magasella Woodsiana*, at one locality only (Moorundi, near Blanchetown), where it occurs in great plenty and of large size. But in the cliffs about Mannum and on the River Bremer palliobranchs occur in great variety and abundance. The commoner forms are *Terebratulina Davidsoni*, *Magasella compta*, *M. Woodsiana*, and *Waldheimia* (?) *divaricata*.

In correlated beds we have in the white limestone at Mount Gambier *Magasella Woodsiana* and *Terebratulina Davidsoni* in abundance; and in the yellow Polyzoal calcareous sands of Aldinga Bay *Magasella Woodsiana*, var., and *Waldheimia ferrata* of infrequent occurrence. The Table Cape beds, Tasmania, are probably not older than the above series; and though the class is represented in them by seven species, yet individuals seem to be rare.

Descending in the scale of our Tertiary deposits we encounter in the glauconitic limestones of the cliffs in Aldinga Bay, and in their probable representatives on the opposite shore of St. Vincent's Gulf, and in the chalk of the Bunda Cliffs in the Great Australian Bight, a palliobranch fauna with a facies very distinct from that of higher horizons. The total number of species collected from them is twenty-one, or seven-elevenths of the known Australian Tertiary species. Of these fifteen do not pass to higher stages of the formation. Many of the

species occur in abundance, such as *Waldheimia pectoralis*, *W. sufflata*, *Terebratulina lenticularis*, and *Terebratula subcarnea*; *Waldheimia Tateana*, which is profusedly abundant, *Terebratula vitreoides*, *Terebratulina Scoulari*, and *T. Davidsoni* occur here of a much larger size than in the higher beds to which they pass up.

In an appended table I have set forth the stratigraphical and geographical distribution of the species.

Alliances.—The facies of our Tertiary palliobranch fauna is, so far as regards genera, most decidedly modern; but the specific points of contact are few. They are notably *Terebratula vitreoides*, *Waldheimia Garibaldiana*, *Terebratulina Scoulari*, *Magasella Woodsiana*, *Thecidium australe*, and *Rhynchonella squamosa*. Nevertheless, not one of the fossil forms is actually known to be represented in living creation. Of the above *T. vitreoides* and *Th. australe* are related to living Mediterranean species, whilst the others have near recent allies in the Australasian region. On the other hand, the great richness in species of *Waldheimia*, more than half of which are of exceedingly large size, gives to the faunula a character peculiarly its own. The presence, moreover, of several biplicated species of that genus is another fact which increases the contrast between our Tertiary and living palliobranch faunas.

A general resemblance seems to subsist between our Tertiary species and those of the European Miocene; but if the Terebratulæ of the latter are correctly so assigned, then the resemblance is in part at least mimetic rather than actual. Thus *Waldheimia grandis* approaches *Terebratula Pedemontana*; *W. insolita* to *Terebratula Hilarionis*; and other similitudes might be pointed out.

The absence of the genera *Megerlia*, *Platidia*, and *Argiope* from our Tertiary fauna, also the paucity of *Rhynchonella*, and the presence of *Magasella*, offer great difficulties to the establishment of any well-defined relationship between the European and Australian Tertiary palliobranch faunas. If we select *Terebratula subcarnea* and the Terebratulinas (excepting *T. Scoulari*), we might, as equally well, claim for the Australian Tertiary palliobranch fauna a Cretaceous facies.

Viewed in its entirety our Tertiary palliobranch fauna has as much a character of its own, as it has affinity with that of the European Caniozoic or to that of recent Australia. But viewed in its duality, then the older is seen to be far removed from recent types, whilst the newer is seen to possess more pronounced affinities with members of the class inhabiting the seas around and adjacent to this continent. In respect to the older fauna, it may be well to recall the fact that two at least of its species (*Waldheimia insolita* and *Rhynchonella squamosa*) are constituents of the fauna of the Upper Eocene

of New Zealand; and I have reason for the opinion that when a careful comparison shall have been instituted between the fossils of the Eocene of New Zealand and those from the Aldinga beds great specific identity will be found to obtain.

Description of Species.

Terebratula vitreoides, T. Woods. Plate viii., fig. 5*a* 5*b*. Plate x., figs. 7*a*—7*b*.

Ref.—Trans. Roy. Soc. New South Wales, 1878, p. 78, figs. 4*a*—*d*.

"A small, smooth, orbicular species, with very conspicuous concentric lines of growth. Foramen small. Of this fossil Mr. Davidson says—'This is another of those undecided forms that resemble many things described as distinct species. It has some resemblance to *T. vitrea* or to *T. orbicularis*, Sequenza, I would not like to assign it positively to any species, although I would not assign to it any very distinguishable features.'"—*T. Woods.*

The specimen which I have figured Plate viii., fig. 5. under the above name is one of a small series from the lower beds at Aldinga, agreeing very well with Woods' description and figures, except that the foramen is usually larger. Of the Aldinga examples I have not been able to dissect out the interior; but somewhat similar shells from the River Murray cliffs prove to have the loop of a *Terebratula*, see plate x., fig. 7. Of the latter I have only been successful in collecting three examples, all of which are smaller than the Aldinga specimens, and differ in being more gibbous with depressed sides, and in having a smaller foramen, characters which approximate it more to *T. vitrea*, Born., whilst the Aldinga specimens make an approach to *T. elliptica*, Sequenza. The differences, which may be due to age, are too slight to justify the specific separation of the two forms.

The loop of *T. vitreoides* differs from that of *T. vitrea* in being relatively shorter and stouter, the breadth of the curved front portion is much greater, and the crural processes are inconspicuously developed.

Dimensions.—A large specimen from Aldinga has the following measures:—Length, 1·45; breadth, 1·05; thickness, ·7 inch. One from the Murray cliffs:—Length, 1·0; breadth, ·8; thickness, ·5 inch.

Locality and Horizon.—Lower Aldinga—glauconitic limestones, Blanche Point, Aldinga Bay; and Middle Murravian, calcareous sands at Blanchetown. (Tate).

Table Cape, Tasmania. (R. M. Johnston).

Terebratula Aldingæ, *spec. nov.* Plate x., figs. 2*a*—2*b*.

Shell obtusely five-sided; a little longer than wide; broadest

about the anterior third; straight or slightly indented in front. Valves moderately convex, the brachial valve more depressed. Surface marked with inequidistant concentric imbricate lamellæ of growth. Punctations of test not visible under a pocket lens, except in thin sections when viewed by transmitted light; punctations minute, widely separated. Beak small incurved and obliquely truncated by a small oval foramen, separated from the umbo of the brachial valve by a small triangular deeply impressed deltidial plate (elements not distinguishable). Interior without a medial septum; of the loop the part posterior to the crura only known. These portions are longer, more slender, and less divergent than in *T. vitreoides*.

Dimensions.—Length, ·9; breadth, ·75; thickness, ·45 inch.

Obs.—Young examples of this terebratulatid and *Terebratella furculifera* closely resemble each other, but the latter is at once known by its densely punctated shell structure and foramen. From *Terebratula vitreoides* it differs especially in its nearly flat brachial valve and pentagonal shape.

Locality and Horizon.—In the glauconitic limestones, north side of Blanche Point, Aldinga Bay. (Twelve examples).

Terebratula (?) subcarnea, *spec. nov.* Plate ix., figs. 1*a*—1*b*.

The interior of this species is not known, and the external characters which belong to *Waldheimia* are not presented by it. It so closely resembles *T. carnea* of the European Cretaceous rocks, that it is only after very careful comparison with many specimens of that species that differences are found to exist. *T. subcarnea* has a larger, though small, foramen; the brachial valve is not so gibbous; and its greatest breadth is nearly medial. These characters partly serve to separate it from *T. carneoides*,* Guppy, of the Antillian Miocene, to which must be added that the front margin of our shell is either straight or slightly depressed.

Dimensions of a large specimen:—Length, 1¾ inches nearly; breadth, 1½ inches; thickness, 1 inch nearly.

Locality and Horizon.—In the top-bed of chalk, Bunda Cliffs, Great Australian Bight. (For the geology of, see vol. ii. p. 104, of this Society's Transactions).

Terebratula (?) bulbosa, *spec. nov.* Plate vii., figs. 5*a*—*b*.

Shell ovate, longer than wide, rounded laterally and attenuated towards the narrow, nearly straight, slightly crenulated front.

Brachial valve very convex, slightly depressed near the

* Quart. Journ. Geol. Soc., London, vol. xxi., t. 19, fig. 3, p. 296, 1866; and Davidson, Geol. Mag., 1874, t. 8, fig. 11, p. 158.

front; interior unknown. Peduncular valve as deep as the opposite valve; beak large, incurved, and obliquely truncated by a large obovate foramen.

Surface smooth, marked by moderate lines and striæ of growth.

Dimensions.—Length, 1·8; breadth, 1·35; thickness, 1·3 inch.

Locality and Horizon.—In the coarse limestones forming the low sea-cliff on the south side of the jetty at Edithburgh, Yorke's Peninsula. (One example).

Waldheimia Garibaldiana, Davidson. Plate xi., figs. 1*a*—1*c*.

Ref.—Geologist, vol. v., p. 446, t. 24, f. 9, 1862.

Id. R. Etheridge, jun., Ann. and Mag. Nat. Hist., vol. 17, p. 17, t. 1, f. 2, 1876.

Syn.—Terebratula sp., Sturt. Two Expeds. in S. Aust., vol. ii., t. 8, f. 15, 1834.

Terebratula compta, Woods. Geol. Obs. in S. Aust., p. 74, wdct., 1862 (non Sow).

Waldheimia imbricata, Woods. Proc. Phil. Soc., Adelaide, fig. 3, 1865; and Trans. Roy. Soc. of N.S.W., p. 79, f. 1, 1878.

Waldheimia macropora, McCoy. Prod. Pal. of Victoria, decade v., pl. 43, figs. 4 and 6, 1877.

W. imbricata, W. Garibaldiana, and W. macropora, Etheridge. Cat. Aust. Fossils, 1878.

W. Garibaldiana is the commonest palliobranch in the middle beds of the River Murray cliffs, and exhibits some slight variation of form and ornament, more particularly in respect to age. The example figured by Etheridge is exceptionally large, and is more angular in outline and more deeply sulcated than the majority of adult specimens which I have seen. In its adolescent stage of growth, which is represented by Sturt's figure, the outline of shell is more or less circular, with slightly convex valves, which are fimbriated; but the front is not depressed, nor is there an appearance of biplication.

The form varies from nearly circular to ovate; and the pentagonal outline, though never obscure in the adult, varies in its angularity, and in the depth of the sulci exhibits much variation, as also the height and number of ribs. The medial depression is occupied with from three to six longitudinal ribs, and the lateral portions of the valves have usually about ten curved ribs on each side.

The loop is that of a *Waldheimia* reaching nearly to the front in a gentle curve, the reflected portion approximating to the long slender erect cruræ, which are rather distant from the hinge plate.

The shell structure is conspicuously punctate as viewed with a pocket lens. The pores are large circular, but not so

numerous as in *W. flavescens* in the proportion of eight.

Dimensions.—A senile example: length, 1·75 1·5 inch; depth, 1 inch.

The specimen figured by Mr. Etheridge, and —Length, 1·5; breadth, 1·25; depth, ·8 inch.

A rather large example, in which the dive peduncular valve and the arched front h prominence, has length, 1·2, breadth 1·0, de

Alliance.—*W. Garibaldiana* bears some *flavescens*, now living off the eastern an Australia; but as pointed out by Mr. T the beak is less elongated, and it has a to which differences has been added the very much larger pores of the test its adult state *W. flavescens* never r development of the frontal sinus observable in all aged examples of

Observations.—Mr. R. Etheridge, referring Sturt's terebratulid to *T* figure represents a fimbriated s totally unlike *T. compta*. The Mr. Woods, who reproduced S the name of *T. compta*; a rec him a few years later, when under the name of *Waldheim* refer to the figure in his " Sturt's, yet as the drawing Transactions of the Philos be a reproduction of one that Sturt's terebratul belong to the one specie

That *W. imbricata*, V *baldiana*, Etheridge, is of many score of spe than one-third inch inches in diameter intermediate form.

I have selected stratum at Blanc which illustrate names of *W.* have been resp

The shell, N.S.W., p. 7 only in its examples o

characters belonging to a *Terebratulina*. It bears some resemblance to my *T. triangularis*.

Mr. Etheridge, l. cit., January, 1876, writes:—"When originally described, *W. Garibaldiana* was supposed to have come from the Tertiary beds of Malta; but Mr. Davidson afterwards satisfied himself that it in reality came from Mount Gambier. The nature of the matrix filling the valves bears out this view, for it agrees exactly in lithological character with that adhering to authenticated specimens from the same locality." One would think from this that all doubt as to the *habitat* of the species was set at rest. But not so Mr. Davidson supplies a note to Mr. Woods (Trans. Roy. Soc., N.S.W., p. 78, 1878), to the effect that the Tasmanian shell referred to under the name of *W. imbricata*, nobis, *W. macropora*, McCoy, M.S., "is a new but allied species, and has also a little resemblance to my *W. Garibaldiana*, although I think not the same species." Prof. McCoy says of it, however:—"I do not know how it can be separated from Davidson's *W. Garibaldiana*." Nevertheless, Prof. McCoy remarks in an appendix to his description of *W. macropora*:—"I should have thought Mr. Davidson's *W. Garibaldiana* identical with this species, but in a letter I have seen from him to the Rev. Mr. Tenison Woods—[referred to above]—he thinks differently." I think it not improbable that Prof. McCoy has misinterpreted Mr. Davidson's remarks, which bear solely upon the possible separation of the Tasmanian shell from *W. Garibaldiana*, and do not necessarily imply that the type of the species is not Australian. As Mr. Davidson observes, "the subpentahedral elongated shape—[of the Tasmanian shell]—is remarkable;" but it can be matched with examples from the River Murray cliffs, and is nothing more than one of the forms of this variable species.

The publication of Davidson's name has priority over that of *W. imbricata*, whilst the latter antedates that of *W. micropora* by several years.

Locality and Horizon.—Upper Murravian, near Morgan, and Muddy Creek, Hamilton; rare and of stunted growth. (Tate.)

Middle Murravian, River Murray cliffs, North-west Bend, Blanchetown, &c. (Sturt, Tate, &c.)

Lower Murravian, River Murray cliffs at Mannum; on the River Bremer, three miles south from Callington; rare. (Tate.)

Mount Gambier (Woods); between Mount Eliza and Mount Martha (McCoy); Table Cape, Tasmania (R. M. Johnston.)

Waldheimia furcata, *spec. nov.* Plate vii., figs. 2*a*—2*b*.

Shell obscurely pentagonal, inflated; valves about equally convex, ornamented with sub-acute ribs, which commence from

the umbonal region and increase in number by bifurcation towards the front, and numerous and close-set transverse lamellæ. The line of contact of the two valves is in one plane, and is only slightly indented by ridges and sulci.

Beak produced, sub-erect to slightly incurved, truncated by a small foramen, and separated from the hinge line by a deltidium. Pores of the test circular few and large, as in *W. Garibaldiana*, but not so numerous in the proportion of four to five. Reflected portion of loop unknown; septum very prominent, extending for about half the length of the valve. Crurœ very short; loop towards its origin, rather broadly compressed, and falcately excavated on the upper side.

Dimensions.—Length, ·8 inch; breadth, ·6 inch; depth, ·5 inch.

Observations.—In its sub-pentagonal form and small foramen it closely resembles *W. Garibaldiana*, from which it is separable by its inflated form, straight front margin, and by the bifurcation of its strongly fimbriated ribs, and in certain details of the loop. It comes nearer to *W. flavescens* than *W. Garibaldiana* does, but, as with that shell, it has a much smaller foramen and fewer and larger pores.

Locality and Horizon.—Rather rare in the Polyzoal calciferous sands forming the lower part of the sea-cliffs immediately to the south of Port Willunga jetty, Aldinga Bay, and at Seaford, near mouth of the River Onkaparinga, St. Vincent's Gulf; at Surveyor's Point, Yorke's Peninsula.

Waldheimia (?) divaricata, *spec. nov.*. **Plate viii., figs. 8*a*—8*b*.**

This species has some resemblance to *W. Garibaldiana*, but is a narrower shell. The brachial valve is less inflated and much depressed in front, and the convexity of this valve is more or less interrupted by a median longitudinal depression, corresponding to which in the other valve is a strong truncated keel. The beak is more depressed, the deltidial area broader, and the beak ridges more conspicuous.

The ribs are *en chevron*, rarely inconspicuous. It also presents in form some agreement with *Magasella Woodsiana*, but in that shell the valves are regularly convex, and the front margin is not angulated.

The loop is unknown, but there is a well-developed septum, which extends for about half the length of the valve. There are no signs of transverse attachments.

Dimensions.—Length, 1 inch; breadth, ·75 inch; depth, ·5 inch.

Locality and Horizon.—In the red raggy limestones of the River Murray cliffs at Mannum (many examples).

Waldheimia Tateana, Woods. Plate vii., figs. 6*a*—6*b*; plate viii., figs. 6*a*—6*c*; plate ix., fig. 2.

Ref.—Terebratula Tateana, Tenison Woods.
Trans. Roy. Soc., N.S.W., p. 79, f. 5, 1878.

Shell longitudinally oval, narrow, widest about the middle; sides slightly rounded, nearly straight in front. Valves moderately convex; surface smooth, marked with a few concentric striæ of growth. Beak long, narrow, sub-erect, truncated by a small circular foramen.

Shell structure conspicuously punctate under a lens; pores oval, large, crowded, rather larger than in *W. Garibaldiana*, but about equal in number.

The loop offers no particular character; in a specimen of a total length of ·8 inch the loop reaches within 1¼ lines of the front.

Dimensions of a median-sized example.—Length, ·8; breadth, ·55; thickness, ·35 inch.

Observation.—The species exhibits considerable variation; typical specimens are insensibly connected with an ovate form, with rounded sides and front. Another phase of its variability is exhibited by the development of a biplicated front, which gives to the shell a subpentagonal outline. In this latter variety the peduncular valve has a broad shallow depression in the middle line bounded by obtuse folds, corresponding with which, in the brachial valve, is a broad median ridge, bounded by two short almost marginal sulci. There are imperceptible gradations connecting the oval, ovate, and subpentagonal shapes; the sulcations are always shallow and limited.

The specimens upon which the species was founded prove on actual examination to be immature examples, though they present the leading characteristics of the adults which I have selected as typical of the species.

Locality and Horizon.—Upper Murravian, near Morgan, R. Murray; Muddy Creek, Hamilton (Tate); Table Cape, Tasmania (Woods). Abundant in the glauconitic limestone to the north of Blanche Point, Aldinga (Tate); Muloowortie clays, Yorke's Peninsula (Tepper).

Waldheimia (?) fimbriata, *spec. nov.* Plate viii., figs. 2*a*—2*b*.

Shell longitudinally ovate, sides and front rounded. Valves moderately convex, the peduncular much the deeper. Surface marked by rounded radial ribs, which extend to about one-third; about five ribs occupy the front, and a like number on each side; the rest of the surface is smooth, with a few concentric striæ of growth. Shell structure conspicuously punctate under a lens.

Beak largish, suberect, and truncated by a large foramen. Loop unknown.

This species has much affinity with *W. Tateana*, particularly with the biplicated variety of it, but the more pronounced costations and the larger foramen separate it.

Dimensions.—Length, ·9 inch; breadth, ·7 inch; depth, ·55 inch.

Locality and Horizon.—Glauconitic limestones, Blanche Point, Aldinga Bay (a few examples).

Waldheimia (?) Johnstoniana, *spec. nov.* Plate viii., figs. 9*a*—9*b*.

Shell elongate, oval, subpentagonal; much longer than wide, with nearly parallel sides, attenuating somewhat rapidly to the beak, but truncated in front. Front margin binsinuate, the sulci shallow and very short, flanked on each side by faint plicæ.

Valves about equally and regularly convex, not inflated. Surface smooth, with a few inequidistant concentric lines of growth. Test minutely and densely punctate, visible under a pocket lens.

Beak short and stout, erect, transversely truncated by a rather large circular foramen; deltidial pieces small, fused together; beak ridges inconspicuous.

Loop unknown, but the brachial valve shows a strongly impressed medial line.

Dimensions.—Length, 1·2; breath, ·7; thickness, ·6 inch.

Observations.—It is allied to *W. Tateana*, through the biplicated variety of that species, but is relatively longer and narrower, and its foramen is much larger, and the beak shorter and stouter.

Locality and Horizon.—Glauconitic limestone, north side of Blanche Point, Aldinga Bay (nine examples).

The species is named after Mr. R. M. Johnston, F.L.S., to whom Australian geologists are indebted for much of their knowledge on the Miocene fauna and geology of Table Cape, Tasmania.

Waldheimia (?) insolita, *spec. nov.* Plate ix., figs. 6*a*—6*b*.

Shell oval, nearly as long as wide; sides and front margins curved; valves moderately convex; surface smooth, with a few concentric lines of growth.

Beak small, erect, depressed, with strong beak ridges, obliquely truncated by a rather small circular foramen. Deltidial pieces well-developed.

Loop that of *Waldheimia*, septum about one-third the length of the brachial valve. Punctations of test visible under a pocket lens.

Specimens collected from a marly band in Blanche Point Cliff, Aldinga, exhibit radial flashes of colour.

Dimensions.—Length, 1·1; breadth, ·9; thickness, ·45 inch.

Observations.—This species has some external resemblance to *Terebratula Aldingæ*, but differs in its rounded outline, in the shape of its beak, and in its smaller foramen. It varies in the degree of convexity of the valves, the more depressed forms recalling the inflated variety of the Liassic *W. numismalis*, but without its circular shape and minute foramen. It also bears a striking likeness to *Terebratula Hilarionis*, Meneghini, from the Eocene of Italy (*vide* Geol. Mag., 1870, p. 401, t. 17, f. 4, 5).

Locality and Horizon.—Glauconitic limestones, Aldinga Bay; upper part of chalk rock, Bunda Cliffs, Great Australian Bight (R. T.); Upper Eocene, New Zealand, the identification based on specimens kindly forwarded by Dr. Hector.

Waldheimia grandis, T. Woods. Pl. xi., figs. 3 and 4.

Ref.—Trans. Adelaide Phil. Soc., 1865, t. 2, fig. 1.

Syn.—W. Gambierensis, Etheridge, jun., Annals and Mag. Nat. Hist., vol. 17, p. 19, t. 2, fig. 4 (1876).

"Shell smooth, very thick, elongated, convex; ventral valve subcarinated, margin with two obscure plaits in the older specimens; beak short, obtuse, obliquely truncated, with a large circular cup-shaped thickened foramen. Loop two-thirds as long as the dorsal valve; lamellæ slender, straight, reflection unknown; septum, as long as loop, gradually tapering; crura thick, semicircular. Length 2·2 inches, breadth 1·4 inches. It is a very variable shell."—T. Woods.

Etheridge's figure represents the adult form of the species, though its dimensions are below the average of fully developed examples. The Rev. J. E. Tenison Woods' illustrations of this species are of a large but somewhat immature specimen, in which the biplicated front, characteristically shown in Mr. Etheridge's drawings, is only commencing to be formed. There cannot be a doubt of the relationship existing between the two shells; they, moreover, came from the same locality.

Etheridge referred his species to *Waldheimia*, solely because a mesial septum was indicated by an impressed line on the brachial valve. Tenison Woods, however, proceeds with more caution, and states that he is not certain if it be probably referred to that genus, though the unreflected portion of the loop was alone unknown to him. Having been fortunate in obtaining a full display of the interior, uncertainty as to the generic position of the species is entirely removed. The loop presents no character worthy of note.

Mr. T. Davidson says:—"It approaches to the Italian

Tertiary *T. Pedemontana*, but still distinct, being more regularly oval."

My notes referring to *W. Tatoana* and reproduced by Mr. Woods, Trans. Roy. Soc., N.S.W., have been by mistake transferred by him to *W. Gambierensis*.

Dimensions of a large example:—Length, 2·4; breadth, 1·5; thickness, 1·3 inches.

Locality and Horizon.—Very abundant in the calciferous sands occupying the middle portion of the River Murray cliffs about Blanchotown and Morgan; rare in the red yellow calciferous sandstone forming the upper part of the Mannum cliffs on the River Murray; River Bremer, four miles south from Callington (Tate). Rather rare in the coralline limestone of Mount Gambier (Woods). Table Cape, Tasmania (R. M. Johnston).

Waldheimia (?) Crouchii, T. Woods. Plate xi., fig. 8.

Ref.—Trans. Phil. Soc., Adelaide, 1865, t. 2, fig. 2.

This species is founded on a brachial valve of nearly circular outline, and with seven large angular plaits on the anterior margin.

Dimensions.—Length, 2·3 inches; breadth, 2·2 inches.

Locality.—Mount Gambier (Woods).

Observations.—This appears to be very distinct from its congeners, but I suspect it to be closely related to *W. grandis*.

Waldheimia MacLeani, *spec. nov.* Plate vii., figs. 1a—1c.

Shell large, a little longer than wide, with a sub-pentagonal outline, convex; greatest width about the anterior third of the whole length, rapidly attenuating posteriorily and gradually narrowing anteriorily to the truncated front margin. Lateral margins narrowly plicate, front margin sinuous. *Brachial* valve regularly convex and deep, ornamented by a few curved costæ, which are limited to near the margin, with an ill-defined medial longitudinal fold bounded by two short depressions. *Peduncular* valve convex deep, the marginal plications more pronounced and longer than in the brachial valve; a shallow depression extends from about the middle of the front, where it is bounded by two rounded plaits each equal in width to the depression. *Beak* moderately produced, sub-erect, truncated by a large circular foramen. *Surface* of both valves with concentric lines of growth.

Young shell ovate, without plicæ, the line of junction of the valves is in one plane.

Dimensions in inches:—

	Length.	Width.	Depth.
(1.)	1·175	1·3	·45
(2.)	1·9	1·4	·5

Observations.—The general shape of *W. MacLeani* is that of *W. Garibaldiana*, but its outline is not so angular, it is more convex, the plications shorter and stouter, and it wants the angular folds of the peduncular valve and the depressed angular front; the foramen is, moreover, very much larger, and the beak more voluminous. Young shells of these two species are very distinct from one another.

The alliance of *W. MacLeani* is rather with *W. grandis*, though strikingly different in shape. Young shells of these species at the same stage of growth show the following distinctive characters :—

W. MacLeani.	W. grandis.
Rounded front	Narrowed front
no fold	mesial folds
margin in one plane	margin flexuous
larger foramen.	smaller foramen.

The species is named after my friend D. MacLean, Esq., J.P., who has rendered great service in the cause of South Australian palæontology, particularly by the bringing to light under great difficulties the cranium of a balænoid whale imbedded in the River Murray Cliffs at Murbko, fifteen miles north of Blanchetown.

Locality and Horizon.—*W. MacLeani* is profusely abundant in a chalky limestone, which commences the limestone and shell beds forming the Upper Murravian series at Blanchetown and northward for about 18 miles. Many of the fossils in this stratum, at a point about three-quarters of a mile south from Mr. MacLean's residence, Glenforslan, are pseudomorphs after selenite, but in the case of the Waldheimias their tests are of the original substance, though their interiors are for the most filled with gypsum. By breaking the shell away there may be obtained most beautiful casts enclosing the loop, the opacity of which makes it a well-defined object as seen through the transparent gypsum.

Waldheimia Vincentiana, *spec. nov.* **Plate x., figs. 1 and 8.**

Shell elongated, oval, much longer than wide, greatest breadth in the middle, whence the shell tapers gradually towards the front and beak; marked with inequidistant concentric lines of growth. Test thick, densely punctated.

Valves nearly equally convex; the brachial valve most convex in the umbonal region. Lateral margin of the valves nearly straight, front margin slightly bisinuated.

Beak short, prolonged, and transversely truncated by a circular foramen of large dimensions. Deltidial pieces distinct, rather small and narrow, beaks moderately well defined.

An impressed line on the surface of the brachial valve, extending for about one-third its length, indicates the existence of a mesial septum. Interior unknown.

A small shell, bearing an external resemblance rather to *W. Vincentiana* than to any other known species, possesses internal characters totally different from those of any Waldheimia. The septum is remarkably long, extending through a distance of ·65 inch of a total curvilinear length of the brachial valve of ·85. The loop is broadly compressed, the forward limb is conduplicate, and is excessively expanded anteriorly and confluent with the returning portion of the loop; at this point the depth is $\frac{1}{4}$th of an inch.

Dimensions.—Length, 2$\frac{1}{2}$ inches; breath, 1$\frac{1}{10}$ inch; depth 1$\frac{3}{10}$ inch.

Observation.—The only species from the Australian Tertiar that bears any resemblance to *W. Vincentiana* is *W. gigas* Woods), which has, however, a more elongated shape, s more attenuated and conspicuously biplicated at the fron

Locality and Horizon.—In the raggy limestones ab mile south from Port Vincent (or Surveyor's Point), w of St. Vincent's Gulf (two examples).

Waldheimia Taylori, Etheridge. Plate xi., fig

Ref.—Annals and Mag. of Nat. Hist., vol. xv f. 8. 1876.

"Shell elongato-ovate, longer than wide; gre the middle. Peduncular valve exceedingly slightly diverging obtusely-rounded ridges the beak towards the front, where they b closing between them a narrow space whic is rounded, and becomes flattened or a l the front of the shell; the lateral por also flattened, but not concave; beak truncated by an oblique circular fo umbo of the brachial valve, but sepa deltidium. Brachial valve, sligh region, becoming almost flat towa in its longitudinal outline a Lateral margins a little flexu concentric lines of growth; sl

Length, 2 inches 3$\frac{1}{2}$ lines; inch 5 lines.

Locality and Horizon.— River cliffs, near the Gre London." Etheridge.

This shell is unknow a narrow form of *W.*

is, however, distinguishable from the Mannum fossil by its broad front and the tripartite division of the peduncular valve. *W. Taylori*, *W. Coriocensis*, and *W. suffiata*, which are of about equal size, are among the largest species of the genus.

Waldheimia Coriocensis, McCoy. Plate ix., figs 4 and 7; plate x., fig. 4.

Ref.—Palæontology of Victoria, Decade v., tab. 43, figs. 1—3, 1877.

Shell sub-ovate, greatest width about the middle, margin of sides convex in the middle. Pedunculated valve very convex or very obtusely carinated along the middle, sides flattened, very slightly convex, becoming slightly concave near the lateral margins; in profile it is much arched near the large incurved beak, becoming tangentially straight towards the front, which is elevated at the margin into a deep sinus (bisinuate when old). Brachial valve flattened in the umbonal half, with lateral margins abruptly deflected at right angles towards the other valve, becoming gradually depressed in the middle towards the narrowed front; in old specimens the mesial depression is divided by a wide slight convexity.

Foramen moderate, deltidium tripartite, the narrow middle portion convex; beak ridges moderate, angulated.

Surface smooth, with moderate lines of growth. Mesial septum about one-half the length of the shell. Length, 2¼ inches. (Abridged from the original diagnosis.)

A few large terebratulids obtained at Mannum seem to agree generally with the example of *W. Coriocensis*, represented by the woodcut on p. 11. The least imperfect of them is shown by fig. 4, pl. x.

A fragment of the umbonal half of a large brachial valve shows some peculiarities of the rostral boss. The hinge plate is broad and deeply concave, the cardinal process is deeply tripartite, the central lobe erect, thick, and compressed, the laterals are divaricate, lamellar, and confluent with the crura. (Pl. ix., fig. 7.)

A single specimen of another large terebratulid (fig. 4, pl. ix.), though differing greatly in its wide and deep mesial depression, is provisionally referred to this species.

Locality and Horizon.—Lower Murravian, rare in raggy limestones at Mannum (Tate).

Miocene Tertiary, Corio Bay, Geelong; Jan Juc (abundant), more rare at Muddy Creek (McCoy).

Dimensions of the specimen, fig. 4, pl. x:—Length, 2·65 inches; breadth, 1·8 inch; thickness, 1·6 inch. Of the variety, fig. 4, p. ix):—Length, 2·2; breadth, 2; thickness, 1·2 inches.

Waldheimia pectoralis, *spec. nov.* Pl. vii., figs. 1a—d.

Shell elongate to elongate-ovate, longer than wide; greatest width near the middle; valves very unequal, lateral margins strongly curved, deflected. Brachial valve strongly convex longitudinally; at the anterior third flattened; with a shallow sulcus proceeding from the beak and widening out to the front margin, which is sinuated or slightly plicate. Peduncular valve very convex and deep, with a flattish triangular area corresponding with the sulcus of the other valve.

Loop reaching to near the front margin; lamellæ slender, with a slight curve towards the central line; reflected portion opening out to three times the width of the other; septum high, extending for three-sevenths of the length of the brachial valve.

Beak produced sub-erect, truncated by a very small foramen, and separated by a large crescentric deltidium of one piece, which is corrugated transversely to its length. Surface of the shell with concentric lamellæ of growth; densely and minutely punctated. Immature shell with a shallow sulcus extending to the front margin, which is depressed and sinuous.

Dimensions—Length, 2·25 inches; breadth, 1·8; thickness, 1·1 inch.

Locality and Horizon.—Not uncommon in the glauconitic limestone, which forms the base of Blanche Point Cliff, Aldinga.

Waldheimia (?) suffata, *spec. nov.* Plate vii., fig. 3; plate viii., fig. 4.

Shell subovate, greatest width about the middle; lateral margins convex in the middle, becoming straight or slightly biisinuated (rarely biplicate) towards the narrow rounded front. Test thick, surface smooth, with numerous moderately strong lines of growth. Shell structure minutely and closely punctate, as viewed under a lens. Peduncular valve very convex in longitudinal direction, and regularly concave. Delt
Beak strongly incurved, slender, foramen minute. P
of one piece, broadly triangular and deeply impressed or flattened
valve very convex, faintly impressed in the middle toward
becoming gradually depressed in the middle toward
what narrowed front.
Septum a little less than half the length of t
unknown.

Dimensions.—Length of a large specimen
1·8; depth, 1·6.

Observations.—This species has th
slender beak of *W. pectoralis*, bu
differences are very great. Som
shape of certain varieties of *W*

general resemblance, *W. suffiata* is at once known by its incurved, minutely perforated beak.

Locality and Horizon.—Rare in the yellow Polyzoal calciferous sands, forming the base of the sea cliffs, south side of Willunga Jetty, Aldinga Bay; and rough shelly limestones at Surveyor's Point and Stansbury, Yorke's Peninsula. Many examples.

Terebratulina Scoulari, *spec. nov.* Plate viii., figs. 3a—3d.

Shell pentagonal, about half as long again as wide, broadest about the middle, tapering gradually towards the truncated front; sides and front slightly curved. Peduncular valve uniformly convex, with a slight median depression in the anterior half of the valve. Brachial valve moderately convex. Surface ornamented with very numerous radiating rounded ribs, which are repeatedly bifurcated; the interspaces rather narrower than the breadth of the ribs; the entire surface crossed by close-set concentric lines of growth; the ribs about the margins of the umbonal regions with imbricating scales.

Hinge line narrow, arched; beak moderate; foramen, in the adult, complete, circular, moderate, laterally margined by small deltidial plates.

Loop that of *Terebratulina*.

Dimensions.—Length, 1·2 inch; breadth, ·75; thickness, ·5.

Observations.—*T. Scoulari* belongs to the group typified by *T. caput-serpentis*, from which it differs in being more depressed and attenuated towards the front, and in having the ribs and concentric lines more numerous and finer; the form of the loop is also different. In shape it closely agrees with *T. Japonica*, as also to the recent Australian species *T. cancellata*. From the latter it differs in its more pentagonal outline, less inflated valves, and coarser ribbing; characters which are very pronounced in the young. The annulus of the loop of *T. Scoulari* is rather subcircular; it is smaller and more contracted than that of either of the above.

The specific name is in compliment to Mr. Gavin Scoular, who has so ably worked out the geology of Munno Para.

Locality and Habitat.—Rare in the Upper Murravian, near Morgan, and at Muddy Creek, Victoria (*Tate*). Common in the Middle Murravian white calciferous sand rock. Not uncommon in the glauconitic limestones of Aldinga Bay (*Tate*). Rare in the Muloowurtie clays, Yorke's Peninsula (*Tepper*).

Terebratulina Davidsoni, Etheridge. Pl. xi., figs. 6a—6d.

Ref.—T. (?) Davidsoni, Annals and Mag. of Nat. Hist., 1876, t. 1, f. 1, p. 16.

"Shell small, oval, flattened, tapering towards the beak, rounded towards the front; lateral margins in one plane, not

nuous. Peduncular valve slightly convex, with the beak but tle produced, truncated by a slightly oblique foramen more less below the apex of the beak, excavated out of its substance, and completed by the two small deltidial plates and the mbo of the brachial valve. Brachial valve almost flat, wit he slightest indication of a mesial sinus in the front; hing ne a little arched. Surface of both valves ornamented wi rge number of fine radiating ribs, occasionally bifurca nd a few concentric lines of growth; margins crenulat *Etheridge*.

The founder of this species, being unacquainted internal portions, placed it with a doubt in th *Terebratulina*, but having seen the loop, which offers character, I can confidently refer it to that genus.

The shell is conspicuous from its almost hemisph the peduncular valve being strongly convex and valve flat, or with a slight medial depression. T are usually somewhat thick and crowded, are nodulated towards the front by strong lines edge of the valves is conspicuously crenulate.

Dimensions of a large and narrow speci width, ·35. One of the ordinary size gives— ·3; depth, ·28 inch.

Locality and Horizon.—This is one of th of our palliobranchs, though not gene commonly the valves are widely gapin

In the Upper Murravian beds ne Murray and cotemporaneous beds Hamilton, Victoria (Tate).

In the Lower Murravian at M coralline limestone at Mount Ga

In the glauconitic limeston ponding beds at Surveyor's Peninsula (Tate).

Terebratulina lenticula

Shell small, broadly ov Brachial valve regularly valve, which is modera the middle line toward numerous rounded, b the front, and with towards the same narrow, slightly r spicuous.

Dimensions.— inch.

Observations.—This species is with some difficulty to be distinguished from *T. Seebachi*, Schloenbach, from the Upper Chalk of Hanover and Oligocene of Saxony, as it resembles it in shape and ormentation. *T. lenticularis* differs, however, in its arched hinge line, smaller and obtuse beak, and in the limited development of the deltidium.

Locality and Horizon.—Abundant in the glauconitic limestones, north of Blanche Point, Aldinga Cliffs (Tate), and in the yellow clays at Muloowurtie, Yorke's Peninsula (Tepper).

Terebratulina triangularis, *spec. nov.* Plate viii., figs. 7*a*—7*d*.

Shell triangularly ovate, a little longer than wide; widest at about the anterior—third; front and sides rounded. Surface ornamented with acute ribs, bifurcating; interspaces linear, fimbriated by imbricating lines of growth. Brachial valve flattish, slightly convex in the posterior part, with a faint median depression towards the anterior, which produces a faintly sinuous front margin. Peduncular valve regularly convex. Beak prominent, acute; hinge line narrow and straight; foramen longitudinal, large, and triangular.

Dimensions.—Length, ·85 inch; breadth, ·8 inch; depth, ·15 inch.

Locality and Horizon.—In the marls at Blanche Point, Aldinga Cliffs, and in the chalky limestone, Bunda Cliffs, Great Australian Bight.

Terebratella Tepperi, *spec. nov.* Plate ix., figs. 8*a*—8*c*.

Rounded, moderately inflated, smooth, with concentric lines of growth. Front margin plane.

Brachial valve regularly and moderately convex to nearly flat. Peduncular valve inflated and medially subangulated. Beak broad, blunt, foramen large, deltidia small, separate.

Loop imperfectly known; but so much as remains in the sole specimen which has been found to afford internal characters is clearly that of *Terebratella*. The medial septum is remarkably short, being less than one-third the length of the valve.

This species belongs to the group typified by the recent New Zealand *T. rubicunda*, Solander, for which it cannot be mistaken.

Dimensions.—Length, ·85; breadth, ·8; thickness, ·45 of an inch.

Locality and Horizon.—"Muloowurtie Clays," near Ardrossan, Yorke's Peninsula (five examples). Collected by Mr. Tepper, to whom the species is dedicated. For an account of the geology of the Muloowurtie Cliffs see his paper Trans. of this Society, vol. ii., p. 74.

Terebratella (?) pentagonalis, *spec. nov.* Plate ix., figs. 5*a*—5*b*.

Shell small, obtusely pentagonal, longer than wide, broadest about the middle. Valves moderately convex, flattened along the middle; surface marked with imbricating lamellæ concentric with the lines of growth.

Beak large, rather produced, obtuse; foramen large, oblong, incomplete; deltidial pieces small. Interior unknown, but the shell is placed in the genus *Terebratella*, because of its incomplete foramen, and general resemblance to *T. rubicunda* and its allies.

Dimensions.—Length, ·65; breadth, ·5; thickness, ·35 of an inch.

Locality and Horizon.—Glauconitic limestone, north side of Blanche Point, Aldinga Bay. Two examples.

Terebratella furculifera, *spec. nov.* Plate xi., figs. 7*a*—7*c*.

Shell orbicular-oval, a little longer than wide; side and front margins in one plane. Valves moderately convex, the peduncular valve a little the deeper, obtusely carinated in the rostral half. Surface smooth, with a few concentric lines of growth; conspicuously punctate under a lens.

Beak small, erect, depressed with strong ridges; truncated by a small triangular foramen; deltidial pieces rather large, disunited.

Septum less than half the length of the valve. Loop doubly attached, first to the diverging portions by transverse processes from the end of the septum, and secondly by a forked process which unites the abruptly truncated terminal bend of the loop to the summit of the extremity of the septum. I have no less than five specimens showing this peculiar conformation of the oop.

Dimensions.—Length, ·65; breadth, ·55; depth, ·3 of an inch.

Observations.—Externally the species resembles *Terebratula Aldingæ* and *Waldheimia insolita*, but may be recognised by the form of its incomplete foramen.

Locality and Horizon.—In the glauconitic limestones, Blanche, Point, Aldinga Bay. Six examples.

Terebratella (?) Woodsii, *spec. nov.* Pl. ix., figs. 10*a*—10*c*.

Ref.—Waldheimia Corioensis, Trans. Royal Society, N.S.W.; p. 79, fig. 3*a*—3*c*, 1878.

The Rev. Mr. Woods referred a small shell with a deep depression on the smaller valve from Table Cape to *W. Corioensis*, McCoy. But until young shells of that species are known, it would be well to regard the identification as bad. The only palliobranch from our Tertiaries, which possess a mesial depression and somewhat similar shape to it is the young

shell of *Magasella compta*, but the beak and foramen of the latter are very small. The excellent figures of the species, drawn by Mr. R. M. Johnston, which I have had reproduced, show a large incomplete foramen, and may therefore indicate a young *Terebratula* or allied form. If the shell be an adult, then it probably belongs to *Terebratella*, where I have ventured to place it.

Locality and Horizon.—Miocene strata, Table Cape, Tasmania (Johnston).

GENUS MAGASELLA, Dall.

The four following species are referred to *Magasella*, because of the strong resemblance they bear to *Terebratella* (?) *Cumingiana*, now transferred by Mr. Davidson to Dall's genus, whose description has not yet reached me. They agree externally in having a prominent beak with a small foramen and the deltidium blended with the shell; the loop presents the characters of *Terebratella*, whilst in others it seems to be related to that of *Magas*.

Magasella compta, Sowerby. Pl. x., figs. 6*a*—6*e*.

Ref.—Terebretella compta, Sow., in Strezlecki's Phy. Desc. of N.S.W., &c., 1845, p. 297, t. 19, f. 4 (*Non* Woods' Geol. Obs. S. Aust., p. 74, 1862).

Terebratella compta, Woods, Trans. Phil. Soc., Adelaide, f. 4*a—b* (? *non* 4*c—e*), 1865. (*Non* Etheridge, jun., Ann. and Mag. Nat. Hist. t. 2, f. 5, p. 19, 1876.)

"Shell smooth, thin trapeziform; lateral margins sub-incurved, anterior margin small obtuse. Hinge area large, with a longitudinal depressed line at either side. Brachial valve triangular, rounded slightly, truncated in front with a small median sinus; peduncular valve faintly keeled. Foramen terminal, small, and round."—Sowerby. To which description Mr. Woods has added brachial valve sub-cordiform, flat, and both valves marked with concentric lines of growth.

The young is nearly circular in outline, with a marginal median sinus in the brachial valve; beak and foramen small, with little or no deltidial area.

The loop is only known by one example (fig. 6*e*); compared with that of *M. Cumingiana*, the following differences are observable:—In *M. Cumingiana* the erect and thick projection of the septum has, in reality, two distinct slender loops attached to it. But in the example before us the loop at its reflection is broadly expanded, and embraces the elevated part of the septum; it then extends into an almost complete circle. It thus has considerable analogy with that of *Magas* (*sensu stricto*). The different dispositions of the loop in *M.*

Cumingiana and *M. compta* arise from the relative massiveness of the septum and loop; in the former the slender loop is lost in the excessively stout septum along which it may be considered to be decurrent, till it becomes again free, and forms the second annulus; whereas in *M. compta* the septum is lost as it were in the much greater mass of the broad lamellæ of the loop, and the loop seems to be only once attached to the septum.

Dimensions of a larger specimen:—Length, ·9; breadth, ·7; depth, ·5 of an inch.

Observations.—*M. compta* being the oldest described among the related forms need not here be compared with them; its salient characters may, however, be pointed out. Trapeziform, contracted, depressed and biangulated in front; hinge line straight, very broad; beak suberect; deltidial area very large. The species has hitherto been almost unknown except by Sowerby's figures and descriptions, as the common shell which is commonly referred to it, is a distinct though allied species. Figs. 4*a* and 4*b* of Mr. Woods' paper, *op. cit.*, doubtlessly represent Sowerby's shell; but his fig. 4*c* agrees well with *M. Woodsiana*, mihi, and I strongly suspect that the interiors shown by figs. 4*d* and 4*e* belong to the same. A comparison of the original figures of *T. compta*, and those of *T. compta*, Etheridge, *op. cit.*, cannot fail to convince one that two species are represented by them.

Locality and Horizon.—Not rare in the Lower Murravian beds at Mannum on the R. Murray, and near Callington, on the R. Bremer. Rare at Stansbury, Surveyor's Point (*Tate*), at Muloowurtie, Yorke's Peninsula (*Tepper*); Mount Gambier, South Australia, and Portland, Victoria (*Woods*).

The types were obtained "from a raised beach at Point Fairy," on the Cape Otway coast, Victoria; but as in other instances, Strezlecki mistook our Older Tertiary deposits for Post Tertiary beaches.

Magasella Woodsiana, *spec. nov.* Plate x., figs. 3*a*—3*d*.

Syn.—Terebratella compta (pars), Woods, loc. cit., fig. 4*c*—4*e* (1865).

id., Etheridge, loc. cit., 1876.

Shell pyriformly ovate, longer than wide, margins flexuous. Valves unequally convex, peduncular valve much the deeper, which is longitudinally and obtusely carinate. Brachial valve regularly convex in the umbonal half, medial depressed towards the front.

Beak broad and stout, slightly incurved and truncated by a nearly transverse circular foramen of moderate dimensions. Hinge line much arched, beak ridges sharply defined, enclosing

a large triangular area, somewhat concave except where interrupted by a broad medial longitudinal ridge.

Surface with concentric striæ and a few ridges of growth; test thin, conspicuously punctate.

A portion of the loop has been illustrated by Mr Etheridge, and very little more of the interior of the adult shell than is there shown is known to me, though a great number of specimens have been sacrificed.

In the adult the medial septum is continued to near the front of the valve, and at about half its length it gives off on each side a flatly expanded process by which it is connected with the diverging portions of the loop. The septum does not appear to have been elevated, as in *M. Cumingiana*. If the specimen to which the following description refers belongs to *M. Woodsiana*, then little remains to complete our knowledge of the interior of the species. Mr. Woods writes:—"Septum round and solid, lamellæ of loop widening to the point of attachment, becoming again contracted at the reflection, and then extending into an almost complete circle with a slight projection towards the hinge."

In young specimens the septum assumes different forms, as I have proved by the examination of more than a dozen specimens from the River Murray cliffs and Muddy Creek. In one from near Morgan the septum is actually adherent to the opposite valve, and the loop shows the same disposition as in *M. compta* (pl. x., fig. 6*e*). Between this form of septum and that of the adult every possible gradation is exhibited.

Dimensions.—Length, ·75; breadth, ·55; depth, ·4 of an inch.

Observations.—*Magasella Woodsiana* bears a considerable external resembance to the recent *M. Cumingiana*, but differs in its less trapezoidal shape, and in the greater breadth and height of the deltidial area. Internally the characters are widely different in detail, and the thick mesial ridge in the interior of the peduncular valve of *M. Cumingiana* is peculiar to that shell. The Port Jackson specimens of *Magasella* presented by the Rev. Mr. Woods, who directed my attention to the similarity between it and the Mount Gambier fossil, seems to me to agree better with Reeve's *Bouchardia fibula* than with *Terebratella Cumingiana*, but which Mr. T. Davidson believes to be only a varietal form of the latter.

Locality and Horizon.—Upper Murravian, near Morgan, and at Muddy Creek (Tate); Lower Murravian, at Morrundi, on the River Murray, near Blanchetown; Mannum; and near Callington (Tate). Mount Gambier (Woods & Tate). Yellow calciferous sands, Aldinga Bay; and at Stansbury (Tate).

Magasella Tenisoni, Woods. Plate xi., fig. 5a—5c.

Reference.—Terebratella Tenisoni, Trans. Phil. Soc., Adelaide, 1865, t. ii., figs. 5*a*, 5*b*, and 6.

"Shell elongated, usually convex. Peduncular valve, trapeziform, keeled deeply, and terminating in a notch at the anterior margin. Brachial valve orbicular and tapering to a point which fits into the notch on the other valve. Beak obtuse, deltidium striated, foramen oblong.

"Septum thickened, curved, and produced so as to touch the opposite valve; attachments of the loops at the centre, and nearer to the shell than to the edge of the septum. Muscular impressions deep. Hinge and crura sloping away from the septum, with a deep sinus in the centre.

"*Size*, variable, but adult specimens 0·7, breadth 0·4 of an inch.

"This curious species has strong points of resemblance to *T. Evansii*, but whose individual characters are very distinct. In both the septum is produced so as to touch the opposite valve."—Woods.

Locality.—Mount Gambier and Portland (Woods).

Magasella deformis, *spec. nov.* Plate x., figs. 5*a*—5*c*.

Shell oblong-ovate, margins of sides convex in the middle. Peduncular valve very convex, obtusely carinated along the middle, sides convex becoming flat or slightly concave near the lateral margins. Brachial valve regularly convex in the umbonal half, with lateral margins abruptly reflected, becoming abruptly and considerably depressed towards the narrowed front.

Beak depressed, truncated by a minute foramen; deltidial area broad and concave; beak ridges well defined.

Surface with a few lines of growth; malleated punctate under a lens.

Mesial septum thick, about half the length of the valve, abruptly produced so as to touch the opposite valve; diverging lamellæ of loop nearly parallel, connected by short transverse processes to the point of origin of the septal projection; thence continued beyond for about half as far again, widening at the inflection, and apparently becoming attached near the apex of the septal projection.

Dimensions.—Length, ·45; breadth, ·8; depth, ·27 of an inch.

Observations.—The reflection of the lateral margins of the valves is a character belonging to the adult shell. In its young state it resembles *M. compta*, and somewhat *M. Woodsiana* at the same stage of growth, but is at once distinguished by its beak and its malleated test.

Locality and Horizon.—In the glauconitic limestones Blanche Point, Aldinga Bay. Nine examples.

Thecidium australe, *spec. nov.* Plate ix., figs. 8*a*—8*c*.

Shell minute, one-eighth of an inch in diameter, triangular-ovate, inequilateral, attached by the umbonal surface of the peduncular valve. Surface smooth, conspicuously punctate, and ornamented by a few thick folds of growth.

Brachial valve flattish; hinge line straight, but interrupted in the middle by a small subquadrate cardinal process; interior unknown.

Peduncular valve, inflated and produced at the umbo, which is obliquely truncated by the surface of attachment; interior with coarse radial striæ, which crenulate the thin margin. Hinge teeth prominent. Within the umbonal cavity is a cup-shaped cavity for the attachment of the adductor muscles, divided longitudinally by a septum, which is continued half as far again beyond it.

This notice is, I believe, the first record of the occurrence of the genus, either recent or fossil in the southern hemisphere.

Locality and Horizon.—In the Miocene strata at Muddy Creek, from which I obtained one perfect shell and four peduncular valves.

Rhynchonella squamosa, Hutton. Pl. ix., figs. 9*a*—9*b*.

Ref.—Cat. Tertiary Mollusca of New Zealand, p. 37, 1873.

Syn.—Rhynchonella cœlata (McCoy, MS.), Woods, Trans. Roy. Soc., N.S.W., p. 77, 1878.

Rhynchonella lucida, McCoy, M.S. (*non* Gould, 1860).

"Shell irregular, more or less orbicular; valves inequal, the ventral flatter with a deep groove; dorsal valve very convex; both with fine radiating scaly striæ. Length, ·7; breadth, ·75; height, ·5. Easily distinguished from *R. nigricans* by its more numerous striæ."—Hutton.

Remarks.—The task of establishing a correct synonym of manuscript names is one that is very properly unattempted by monographers; but in this instance the manuscript names of McCoy have a fictitious value from the fact that they have been published with such remarks as may lead up to their identification. The Rhynchonella found at Table Cape, Tasmania, was pronounced by Tenison Woods (Trans. Roy. Soc. Tasm., p. 15, 1874) to be identical with *R. lucida* of McCoy, common in the Geelong Miocene beds; subsequently we find the same author (Trans. Roy. Soc, N.S.W., 1878) referring to it as *R. cœlata*, McCoy. Doubtless the two names have been given to the same shell; and it is probable that the change of denomination was

necessitated by the knowledge of the prior occupation of the cognomen *lucida* by a recent shell described by Gould in 1860.*

The identity of *R. cælata* with *R. squamosa*, Hutton, rests upon the characters given to it by Mr. Woods, and upon the observations of Mr. Davidson published therewith (op. cit. p. 77).

"Rounded trigonal, with a strong mesial fold, with many fine imbricating ribs."—T. Woods.

"A most beautiful species, very closely related to *R. nigricans*, from New Zealand. Some examples in external shape cannot be distinguished, but I have not observed on any recent *R. nigricans* such prominent and strongly marked imbricated striæ. The fold and sinus seem more strongly marked on the fossil form. The ribs also seem smaller or more delicate than on real *nigricans*."—T. Davidson.

It will be observed that Mr. Davidson uses the same characters to distinguish the fossil from the recent *R. nigricans* as Prof. Hutton had previously employed in founding the species *R. squamosa*.

Locality and Horizon.—In the glauconitic limestone, north of Blanche Point, Aldinga Cliffs (*Tate*); yellow clays of Muloowurtie (*Tepper*), and at Stansbury (*Tate*), Yorke's Peninsula; on the R. Bremer, at Salem, near Callington (*Tate*).

Muddy Creek, Hamilton (*Tate*), and from several Miocene beds in Victoria (*McCoy*); Table Cape, Tasmania (*T. Woods*); Oamaru Formation (Eocene) Broken River, New Zealand (*Hutton*).

Explanation of Plates.

Plate VII.

Fig. 1. *Waldheimia pectoralis*, natural sizes. Aldinga. *a* and *b*, two views of an adult shell; *c* and *d*, id of a young shell.
Fig. 2a-b. *Waldheimia furcata*, natural size. Aldinga.
Fig. 3. *Waldheimia sufflata*, natural size. Surveyor's Point.
Fig. 4. *Terebratulina lenticularis*, much enlarged. Aldinga. *a*, brachial valve; *b*, lateral view of both valves; *c*, front view.
Fig. 5. *Terebratula bulbosa*, *a-b*, two views, natural size. Edithburgh.
Fig. 6. *Waldheimia Tatoana*, *a-b*, two views of the same specimen, natural size. Aldinga.

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* This species is described as "sub-circular—under the lens radiately striated," and has no analogy with our fossil.

Plate VIII.

Fig. 1. *Waldheimia Macleani*. Blanchetown. *a-b*, two views of the same specimen, natural size; *c*, brachial valve of a young shell, natural size.

Fig. 2. *Waldheimia fimbriata*. Aldinga. *a-b*, two views of the same specimen, natural size.

Fig. 3. *Terebratulina Scoulari*. Blanchetown; *a*, brachial valve natural size; *b*, enlarged view of portion of the same; *c*, slightly enlarged view of the loop of another specimen; *d*, a young shell, slightly enlarged.

Fig. 4. *Waldheimia sufflata*; lateral view of specimen, natural size, plate vii., fig. 3.

Fig. 5. *Terebratula vitreoides*; *a-b*, two views of the same specimen, natural size. Aldinga.

Fig. 6. *Waldheimia Tatcana*; *a-c*, three views of a biplicated example, natural size. Aldinga.

Fig. 7. *Terebratulina triangularis*, slightly enlarged; *a-c*, three views of a specimen from Aldinga; *d*, brachial valve from Bunda Cliffs.

Fig. 8. *Waldheimia divaricata*; *a-b*, two views of the same specimen, natural size. Mannum.

Fig. 9. *Waldheimia Johnstoniana*; *a-b*, two views, natural size. Aldinga.

Plate IX.

Fig. 1. *Terebratula subcarnea*; *a-b*, two views of the same specimen, natural size. Bunda Cliffs.

Fig. 2. *Waldheimia Tatcana*, natural size. Stansbury.

Fig. 3. *Thecidium australe*. enlarged views. Muddy Creek. *a*, brachial valve; *b*, interior of peduncular valve, a portion of the hinge area has been removed to show the adductor impressions; *c*, lateral view of the specimen, fig. 3*a*.

Fig. 4. *Waldheimia Corioensis*, McCoy (?); natural size. Mannum (?)

Fig 5. *Terebratella pentagonalis*; *a-b*, two views, natural size. Aldinga.

Fig. 6. *Waldheimia insolita*, natural sizes; *a*, from Bunda Cliffs; *b*, from Aldinga.

Fig. 7. *Waldheimia Corioensis*; interior view of the umbonal part of a brachial valve, natural size. Mannum.

Fig. 8. *Terebratella Tepperi*. Muloowurtie; *a-b*, two views of the same shell, natural size; *c*, interior of brachial valve of another specimen, natural size.

Fig 9. *Rhynchonella squamosa*, natural sizes; *a*, fragment of a peduncular valve, R. Bremer; *b*, perfect shell from Aldinga.

Fig. 10. *Terebratella Woodsii.* Table Cape; three views, natural size (copied from drawings of the original by Mr. R. M. Johnston).

Plate X.

Fig. 1. *Waldheimia Vincentiana*, natural size; Surveyor's Point; *a*, brachial valve; *b*, lateral view of both valves.

Fig. 2. *Terebratula Aldingæ*, natural size; Aldinga; *a*, brachial valve; *b*, lateral view of both valves.

Fig. 3. *Magasella Woodsiana.* R. Murray cliffs; *a*, brachial valve; *b*, lateral view, natural size; *c*, interior of brachial valve of another specimen, natural size; *d*, lateral view of loop and septum of another specimen, somewhat enlarged.

Fig. 4. *Waldheimia Corioensis*, natural size. Mannum.

Fig. 5. *Magasella deformis.* Aldinga; *a-b*, different views of the one specimen; *c*, interior view of another. All slightly enlarged.

Fig. 6. *Magasella compta.* Mannum; *a-b*, two views of the same shell; *c*, brachial valve of another specimen; *d*, of a third—all natural sizes; *e*, interior view of a young shell, enlarged.

Fig. 7. *Terebratula vitreoides*, natural size. Blanchetown. *a*, brachial valve; *b*, interior view of the same.

Fig. 8. *Waldheimia Vincentiana*, natural size. Surveyor's Point. Portion of brachial valve removed to show reflected lamellæ of loop.

Plate XI.

Fig. 1. *Waldheimia Garibaldiana*; *a-c*, similar views of three examples; natural sizes. Blanchetown.

Fig. 2. *Waldheimia Taylori*, natural size (copied).

Fig. 3. *Waldheimia grandis*, natural size. Blanchetown.

Fig. 4. id, young example.

Fig. 5. *Magasella Tenisoni*; *a-c*, natural sizes (copied).

Fig. 6. *Terebratulina Davidsoni*; *a-c*, three views of the same shell, enlarged; Mannum; *d*, brachial valve of a very large example, natural size (the loop is preserved in this specimen); Aldinga.

Fig. 7. *Terebratella furculifera.* Aldinga. *a*, brachial valve; *b*, side view of the same shell—natural sizes; *c*, interior of the brachial valve of another specimen.

Fig. 8. *Waldheimia Crouchii*, slightly reduced (copied).

TABLE SHOWING THE GEOGRAPHICAL AND STRATIGRAPHICAL DISTRIBUTION OF THE SPECIES.

SPECIFIC NAMES.	AUTHORS.	LOCALITIES AND HORIZONS.										
		1	2	3	4	5	6	7	8	9	10	11
Terebratula vitreoides	Woods	•					•		•			
Aldingæ	Tate	•										
subcarnea	Tate			•								
bulbosa	Tate		•									
Waldheimia Garibaldiana.....	Davidson					•	•	•	•	•	•	•]
furcata	Tate				•							
divaricata	Tate					•						
Tatcana	Woods	•	•						•		•	•
fimbriata	Tate	•										
Johnstoniana	Tate	•										
insolita	Tate	•		•								
grandis	Woods					•	•	•	•			
Crouchii.....	Woods							•				
McLeani.....	Tate											•
Vincentiana	Tate		•									
Taylori	Etheridge					?						
Coriocnsis	McCoy					•				•	•	
pectoralis	Tate	•										
suffiata	Tate	•	•									
Terebratulina Sculari	Tate	•	•				•				•	•
Davidsoni	Etheridge	•	•			•		•			•	•
lenticularis	Tate	•										
triangularis	Tate	•		•					?			
Terebratella Tepperi	Tate		•									
pentagonalis	Tate	•										
furculifera	Tate	•										
Woodsii	Tate								•			
Magasella compta	Sowerby		•			•		•		•		
Woodsiana	Tate		•		•	•		•			•	•
Tenisoni	Woods							•				
deformis	Tate	•										
Thecidium australe	Tate										•	
Rhynchonella squamosa	Hutton	•	•			•			•		•	
TOTALS.....	..	16	10	3	2	9	4	7	6	3	8	7

INDEX TO LOCALITIES.

Inferior Beds.—1. Glauconitic limestones at Aldinga.
2. Muloowurtie clays and other lower beds.
3. Chalk rock, Bunda Cliffs.

Middle Beds.—4. Calciferous sands, Aldinga.
5. Lower Murravian.
6. Middle Murravian.
7. Mount Gambier, white limestone.
8. Table Cape.
9. Geelong, &c.

Superior Beds.—10. Muddy Creek.
11. Upper Murravian.

MISCELLANEOUS CONTRIBUTIONS

TO THE

NATURAL HISTORY of SOUTH AUSTRALIA.

ZOOLOGY.

UNIO STUERTII, *Adams* and *Angas*, "immense quantities of which are found in the rainwater holes at Umbum, 40 miles south from Peake; natives eat them, but they are anything but palatable." (J. Chandler.) The species was described from specimens collected at Newcastle Waters by the Stuart Trans-continental party.

PHYSA TEXTURATA, *Reeve*; 20 miles from Peake, towards Lake Eyre. (J. Chandler.) (R. Tate.)

CYRENA ANGASI, *Prince*; as large as those obtained from the Reedbeds, exhibited before the Society January 7, 1879. PHYSA ALICÆ, *Reeve*, and UNIO VITTATUS, in the River Onkaparinga, at Noarlunga (Master Molineux). (R. Tate.)

BOTANY.

PLANTS collected by Mrs. Richards, Corr. Memb., at Fowler's Bay:—

PLAGIANTHUS GLOMERATUS, *Benth.*; previously known localities are "south coast" and near Lake Eyre.

ACACIA HOMALOPHYLLA, *A. Cunn.* Reported widely diffused about Fowler's Bay. The ripe pods which accompany the specimens contain seeds attached by a very long and bright red funiculus. The funiculus is doubly folded on the sides of the seed, and is detached with it; and from its brilliant colour is supposed to serve as an attraction to birds, and so assist in the dissemination of the species. The seeds are largely fed upon by *Cacatua Leadbeateri*. The species extends to the oasis of the Bunda Plateau, and northward to the Musgrave Ranges.

SOLANUM HYSTRIX, *R. Br.* Baron F. von Mueller writes:—"I never saw this rare plant before, as it was only once found, *i.e.*, in 1802, at Petrel Bay, by R. Brown." Some of the particulars he asks for I have supplied from personal observation made during my exploration around the Great Australian Bight. It is confined to the sandy ridges covered with mallee

which alternate with the loamy and grassed flats between the head of the Bight and Colona, near Fowler's Bay. I first saw it in flower on January 27, 1879, its large pale blue corolla being in strong contrast with the yellowish green of its foliage; no fruits were then noticed.

EREMOPHILA CRASSIFOLIA, *F. M.* This is another plant peculiar to South Australia, hitherto known from Mount Greenly, Dombey and Venus Bays, Eyre's Peninsula. The Fowler's Bay specimens represent a small leaved variety.

THYSANOTUS BAUERI, *R. Br.*, previously known from the Adelaide district. (R. Tate.)

Baron F. von Mueller reports the following plants collected by Mrs. Richards at Fowler's Bay and vicinity:—*Sisymbrium trisectum*, *Capsella cochlearina*, *Geococcus pusillus*, *Pimelea serpyllifolia*, *Pomax umbellata*, *Aster calcareus*, *A. magniflorus*, *Echinospermum concavum*, *Hypoxis glabella*, *Arthropodium minus*, *Poa lepida*, and *P. nodosa*.

"Among a few plants collected by Mr. Tietkins, at Pedinga, in the same district, is *Limosella Curdieana*, F. M. I am not sure whether it has been noted as S. Australian. At all events we did not get it from a place so far west. Also *Kochia fimbriolata*, *Lavatera*, *Helichrysum Lawrencella*, *Erodiophyllum*, and *Bulbine semibarbata*." (F. v. M.)

The following places quoted under South Australia in the Flora Australiensis should be transferred to Victoria:—Skipton, Forest Creek, Buffalo Range, Plenty Creek, Fifteen-Mile Creek, Loddon River, and Mount Disappointment.

LIST OF PLANTS collected by Mr. Chandler at Barrow's and Tennant's Creeks.

A collection of about 90 species of flowering plants, collected by Mr. Chandler while acting as Telegraph Master at the above-named stations, has been submitted to Baron von Mueller, whose determinations here follow. The collection was not made in the interest of botanical science, and in consequence is for a large part not in a good state for specific determination. However, it is of value, as coming from a district which was hitherto unknown botanically, and enables me to enlarge the geographical range of several species. Barrow's Creek is situated within the tropics, lat. 21° 30′, and Tennent's Creek is 147 miles further north.

Of the 49 determined species, 22 are not catalogued for Tropical South Australia by Dr. Schomburgk in his "Flora of

South Australia. They are all the Malvaceæ, *Kochia villosa*, *Petalostylis labicheoides*, *Psoralea patens*, *Glycine elongata*, *Scævola depauperata*, *Tecoma australis*, *Eremophila MacDonelli*, *Cyperus squarrosus*, *C. decompositus*, *Chloris scariosa*, *Eleusine cruciata*, *Triraphis mollis*, *Andropogon laniger*, *Lappago racemosa*, *Perotis rara*, *Pappophorum commune*, and *Eriachne obtusa*. Twelve of the above are recorded by Dr. Schomburgk as occurring in the extratropical parts of the province, but the remaining ten have no place in his lists; they are—*Hibiscus Sturtii*, *Gossypium australe*, *Tecoma australis*, *Cyperus squarrosus*, *Eriachne obtusa*, and *Andropogon laniger*, which are now known to extend into extratropical South Australia; and *Glycine elongata*, *Cyperus decompositus*, *Chloris scariosa*, and *Perotis rara*, which are restricted in Australia to tropical regions. (R. Tate.)

In the following list the letters B., T. prefixed to the specific names refer to the localities Barrow's Creek and Tennant's Creek respectively:—

TILIACEÆ.

T. Corchorus sidoides, *F. M.*

MALVACEÆ.

B. Malvastrum spicatum, *A. Gray;* B. Sida corrugata, *Lindley;* B.T. Abutilon Fraseri, *J. Hooker;* T. Hibiscus Sturtii, *J. Hooker;* B.T. Gossypium australe, *F. M.*

EUPHORBIACEÆ.

B.T. Euphorbia Drummondii, *Boiss.*

AMARANTHACEÆ.

B. Ptilotus obovatus, *F. M.;* B. P. incanus, *Poir.;* B. Achyranthes aspera, *Linné.*

CHENOPODIACEÆ.

B. Kochia villosa, *Lindley, var.*

FICOIDEÆ.

B. Trianthema pilosa, *F. M.*

LEGUMINOSÆ.

B. Crotalaria dissitiflora, *Bentham;* B. Psoralea patens, *Lindley;* B. Indigofera hirsuta, *Linné;* B. Glycine elongata, *F. M.;* B. Erythrina vespertilio, *Sw.;* B. Petalostylis labicheoides, *R. Br.*

PROTEACEÆ.

Grevillea Wickhami, *Meisen.* Forster's Range.

CUCURBITACEÆ.

B. Cucumis acidus, *Jacq.;* B. Mukia scabrella, *Arnott.*

LORANTHACEÆ.

B. Loranthus pendulus, *Sieb., var.* cana (L. Quandang, *Lindl.)*.

COMPOSITÆ.

B. Pterocaulon sphacelatus, *Benth.;* B. Helichrysum apiculatum, *De Cand.*

GOODENOVIEÆ.

B. Scævola depauperata, *R. Br.*

ASCLEPIADÆ.

B. Cynanchum floribundum, *R. Br.*

CONVOLVULACEÆ.

B. Ipomœa eriocarpa, *R. Br.*
B.T. Evolvulus linifolius, *Linné.*

BIGNONIACEÆ.

B. Tecoma australis, *R. Br.*

MYOPORINCEÆ.

B. Eremophila Latrobei, *F. M.*; MacDonnelli, *F. M., var.;* longifolia, *F.M.*

ACANTHACEÆ.

B. Justicia procumbens, *Linné.*

COMMELINACEÆ.

B. Commelina ensifolia, *R. Br.*

CYPERACEÆ.

B. Cyperus decompositus (?) *F. M.;* C. squarrosus, *Linné:*

GRAMINEÆ.

T. Panicum decompositum, *R. Br.;* B. Setaria glauca, *Beauvoir;* Lappago racemosa, *Willd.;* Andropogon laniger, *Desf.;* Aristida stipoides, *R. Br.;* Anthistiria ciliata, *Linné;* Perotis rara, *R. Br.;* Pappophorum commune, *F. M.;* Triraphis mollis, *R. Br.;* Chloris scariosa, *F. M.;* Eleusine cruciata, *Lamarck;* Eriachne obtusa, *R. Br.*

FILICES.

B.T. Cheilanthus tenuifolia, *Sw.*

PROBABLE CURATIVE PROPERTIES OF MELALEUCA UNCINATA.

Somewhat more than a week ago Mr. Earle, of Pine Point, Muloowurtie, mentioned in conversation to me that he had found accidentally great relief and speedy cure, when suffering from violent catarrh, by crushing between the teeth, and

swallowing the juice of the green leaves of a certain plant occasionally occurring in patches near his residence. He had advised some of his men to try the same remedy and they had experienced the same salutary result. Pointing the plant out to me, I found it to be *Melaleuca uncinata*, R. Br. It is a shrub with a woody stem one to two inches in diameter and from three to eight feet in height. The branches grow straight, upright, and are rather slender; the leaves cylindrical, about one inch long, and pointed; the flowers occur in small brush-like groups around the young twigs, and are whitish; the fruits form closely packed, short cylinders, around the branches; the popular name applied here to this shrub is "broom," and it is quite characteristic of granitic soil. Having made a mental note of the information I resolved to try it myself should occasion arise. The latter days of last week I was much troubled with a violent catarrh, stiff neck, cough, and a difficulty in swallowing. Obtaining a small sprig, I chewed a few leaves (two or three) at irregular intervals. In two days the latter symptoms had altogether disappeared and the catarrh so much abated that it no longer incommoded me. No other remedies were used. In case some of the learned members of the Society would feel inclined to examine the plant chemically in order to determine its probable medicinal character, some specimens accompany this note. The taste shows the existence of a not disagreeable aromatic oil.

J. G. Otto Tepper, Corr. Mem.

Ardrossan, 26th March, 1880.

Appendix to the List of Plants about Ardrossan,

By Mr. Otto Tepper, F.L.S., Corr. Mem.

The species have all been determined by Baron F. von Mueller.

CRUCIFERÆ.

Alyssum minimum, *Pallas*. T.
Cardamine laciniata, *F. M.* C.
Geococcus pusillus, *Drummond* and *Harvey*. C.

POLYGALEÆ.

Comesperma calymega, *Labillardiere*. (?) C.

CARYOPHYLLÆ.

Drymaria filiformis, *Bentham*. T.

PORTULACEÆ.

Claytonia pusilla, *F. M.* Muloowurtie, C.
Claytonia pygmæa, *F. M.* Muloowurtie, P.

FICOIDEÆ.

Trianthema humillima, *F. M.* Maitland road, P.

SALSOLACEÆ.

Atriplex Muelleri, *Bentham.* C.
Atriplex microcarpum, *Bentham.* C.
Suæda maritima, *Dumortier.* Saltmarshes, C.
Kochia humillima, *F. M.* C.

MALVACEÆ.

Plagianthus glomeratus, *Benth.* T. and P.

STERCULIACEÆ.

Thomasia petalocalyx, *F. M.* Maitland sandhills, T.

SAPINDACEÆ.

Dodonæa Tepperi, *F. M.* T, rare.

LEGUMINOSÆ.

Goodia medicaginea, *F. M.* Kilkerran.
Acacia acinacea, *Lindley.* Black Point, Muloowurtie, C.

HALORAGINEÆ.

Loudonia Behrii, *Schlechtendal.* Muloowurtie and Maitland sandhills, T. (?).

MYRTACEÆ.

Leptospermum lævigatum, *F. M.* Muloowurtie sandhills and coast, and Black Point, G.
Eucalyptus dumosa, *A. Cunn.* T. and P.

UMBELLIFERÆ.

Hydrocotyle rugulosa, *Turczaninow.* Maitland sandhills, T.
Didiscus pusillus, *F. M.* Muloowurtie, P.

COMPOSITÆ.

Podolepis Siemssenia, *F. M.* Muloowurtie, P.
Helichrysum obtusifolium, *Sond.* P.
Centipeda Cunninghami, *F. M.* T. and P.

STYDIDIEÆ.

Stylidium calcaratum, *R. Br.* Maitland sandhills.

GOODENOVIEÆ.

Scævola linearis, *R. Br.* Maitland, T. and P.

EPACRIDEÆ.

Styphelia Richei, *Labill.* Black Point, C.

LOGANIACEÆ.

Mitrasacme paradoxa, *R. Br.* Muloowurtie, P.

MYOPORINEÆ.

Eremophila viridiflora, *F. M.* P.

ORCHIDEÆ.

Thelymitra carnea, *R. Br.* Yorke Valley, T., rare.
Lyperanthus nigricans, *R. Br.* Maitland sandhills, T.
Acianthus exsertus, *R. Br.* P.
Caladenia carnea, *R. Br.* T. and P.

LILIACEÆ.

Chamæscilla corymbosa, *F. M.* Yorke Valley, T., rare.

RESTIACEÆ.

Centrolepis aristata, *Roem.* and *Schult.* Maitland sandhills, T.
Centrolepis aristata, *var.* pygmæa. Muloowurtie, P.

CYPERACEÆ.

Lepidosperma viscidum, *R. Br.*, C.
Schœnus Brownii, *J. Hooker.* Maitland sandhills, T.
Schœnus Tepperi, *F. M.* G.

GRAMINEÆ.

Sporabolus Virginicus, *Kunth.* Winulta, P.
Danthonia nervosa, *J. Hooker.* Yorke Valley, T.

FILICES.

Cheilanthes distans, *R. Brown.*

Geococcus pusillus is remarkable for being strongly suspected of having two widely different forms. The principal one pushes its fruit *below* the soil while perfecting and ripening; the other, generally a weaker plant, has an upright stalk, and resembles very much a *Cardamine*. It is not very common, and occurs generally where an accumulation of decayed animal matter has enriched the soil, as in the camping place of cattle.

Comesperma calymega is not yet fully identified, as a doubt exists whether it may not prove to be *C. defoliatum*, F. M. It grows among the grass near the coast, near Rogue's Point, Muloowurtie.

Drymaria filiformis is quite new to the province, having hitherto only been known from the Irwin River, W. Australia. It is an elegant little plant, resembling a *Claytonia*, and was found flowering in the latter part of September, in the mallee scrub, near the Kalkabury road, five miles from Ardrossan.

Of similar interest is *Trianthema humillima*, which, as Baron F. v. Mueller informs me, had formerly only been known from one locality, between the Rivers Darling and Lachlan. It occurs here on low ground on the Maitland road near the boundary of the Hundred of Cunningham, and is most probably

the smallest of all phanerogamic plants of the world; the tallest specimen scarcely exceeds one-eighth of an inch. It has not been seen, though looked for, at any other locality.

Kochia humillima is also new to the province, its proper habitat being Victoria. It is a small plant, and is becoming very rare through the cropping of the sheep.

Plagianthus glomeratus occurs only in the northern part of the Hundred and beyond, but occasionally a stray specimen is seen near Ardrossan. It is a much smaller plant than its congener, *P. spicatus*. The latter only flourishes once, and once only, on newly-burnt soil, the seed then becoming latent, till another fire starts it into growth. Acres of dead stalks, five to seven feet high, may be seen in fertile parts of the scrub, and not a single young plant comes up for years.

Dodonæa Tepperi, F. v. M., is a new species, distinguished by its dense low growth, very small leaves, and a quadrilateral speckled fruit. Only one plant has as yet been found on a stony hillside, near Ardrossan.

Goodia medicaginea is new for the locality, and was obtained from Kilkerran by Dr. Engelhardt, of Maitland.

Acacia acinacea has only been seen here on the low plain at Black Point, but was formerly observed in great plenty near Monarto and at Truro on stony hills. It has a silvery grey leaf.

Hydrocotyle rugulosa had not before been known out of W. Australia, but Baron F. v. Mueller remarks, has perhaps been overlooked and taken for *H. capillaris*. It occurs sparingly in the mallee scrub of Muloowurtie and the sandhills near Maitland.

Helichrysum obtusifolium has been only obtained in one specimen near Ardrossan. Its leaves appear to die off when in full bloom.

Stylidium calcaratum is new for the locality. It is a very small plant, scarcely a quarter of an inch long, but the stalk is about one and a half inches, and the flower very large for its bearer. It was profusely abundant for the space of a few square yards near the sandhills N. of Maitland, while round about not any could be discerned.

Thelymitra carnea is one of the rarest of our orchids, and also new for the locality, it having before only been found about Mount Lofty. The specimen was found growing under the protection of an old brush fence in Yorke Valley. Under similar circumstances *Chamæscilla corymbosa* was found.

Lyperanthus nigricans has nowhere else been observed by me than among the sandhills near Maitland. It is a beautiful orchid, that obtained its specific name from drying perfectly black. *Acianthus exsertus* and *Caladenia carnea* occur often in

society, but the former only and exclusively on granite soil under *Melaleuca uncinata*.

Schœnus Tepperi, F. v. M., is a new species, occupying rocky dry hillsides and summits, chiefly in the neighbourhood of granite, where it flourishes best.

Cheilanthes distans, R. Br., has only been found in one spot of a few yards square growing on a metamorphosed hornblendic schist, altered by contact with granite into a jaspery, green and white banded stone.

GEOLOGY.

Rock formations and minerals in the vicinity of Peake, C.A., being a report by Professor R. Tate on specimens forwarded by Mr. J. Chandler.

PRE-SILURIAN.—The hill country is constituted principally of *micaceous* and *hornblendic slates*, but *talcose* slate also occurs, and *diorite* is abundant. The quartz veins in these metamorphic rocks yield an abundance of *micaceous iron-ore*, and specimens of calcite with copper pyrites and purple copper and green carbonate of copper have been obtained from them.

JURASSIC.—A dense gray earthy fossiliferous limestone from Peake contains the following species of fossils, but in a bad state of preservation:—*Monotis Barkyli*, Moore; *Cytherea Clarkei*, Moore; *Pleuromya* sp.; *Lingula* sp.

A similar fossiliferous rock is reported by Mr. Chandler, on the information of Mr. Cameron, the manager on Mr. A. B. Murray's run at Cootanoorina, 30 or 40 miles west from Peake, to have been discovered in that place in a well 30 feet deep on the banks of the Peake Creek. "The rock is a mass of fossilised mussel shells, which are about the size of a man's hands closed and pressed together."—J. C. The fossils here referred to are casts of *Cytherea Clarkei*. Mr. R. Beetson communicates fossils obtained by him at the foot of Mount Margaret. They are *Belemnites* sp., *Dentalium* sp., *Chione* sp., and a small compressed, sub-equilateral *Pleuromya*. He assures me that the Jurassic rocks occupy the low country, and that the "spring-mounds" are based upon them.

DESERT SANDSTONE.—Among the specimens probably derived from beds of this age are:—

Brown hydrous oxide of iron-boxes, "found on the stony ridges eight miles north of Peake, under Mount Kingston Range; no springs in immediate vicinity." *Natural marbles* or *stone bullets*, which are terms that may appropriately be applied to spherical masses of quartzose sand cemented by brown

hydrous oxide of iron, "found in great plenty on the rises on which the previously-mentioned specimens were taken." The marbles are solid throughout, and do not exhibit any signs of having acquired their spherical shape by rolling, particularly as several examples present prominently projecting fragments of quartz.

From the table-lands specimens of chalcedonic quartz and jasper stones "are found scattered about amongst the loose surface quartz on the flats four miles west of this."

Recent.—Deposits from the springs at Peake. "The surface covering of the flat around the spring" is a fine sand cemented by calcareous matter; exterior surface of specimen botryoidal. A dense calcareous tuff "from spring flats at Peake." A red ochre with gypsum "found near the springs." A cellular calcareous tuff forms "the top crust of the mound-springs." An opalescent quartz is "a common specimen taken from the springs."

The above specimens prove most conclusively that the mounds are composed of mineral matter deposited from the water of the springs, and do not owe their form to volcanic action, as is popularly supposed, and has been insisted upon by some observers (see Trans. of this Society, 1879, p. *l.*)

Tourmaline.—A large prismatic piece, about 1½ inches diameter, from Mount Boothby, 90 miles north of Alice Springs, where it is said to be abundant. "If I am not mistaken, I have seen plenty of it, only in smaller pieces, running in veins through quartz near the Barrow's Creek Telegraph Station." J. C.

Mica, in large transparent plates. "In large quantities in the MacDonnell Ranges." J. C.

Magnetic iron ore, "locality uncertain, but suspected to have been found in this neighbourhood." J. C.

Hard kaolin clay, "obtained from a high table land hill eight miles south-west from Charlotte Waters. A quarry of this was opened there, and the station was built of it; it also makes excellent tobacco pipes." J. C.

Graphic Granite.—Mr. Otto Tepper forwards a specimen of graphic granite consisting of red felspar and translucent quartz arranged prismatically, so that in a cross section the felspar appears to be interspersed with graphic lines of quartz. He writes:—"It was discovered on the north side of the Maitland-road, on the eastern incline of Yorke Valley ridge, Yorke's Peninsula, forming a dyke of a few yards in width between the gneissic rock. The strike of the dyke is indistinct,

but appears to be S.E. and N.W. The scrub, composed of *Melaleuca uncinata*, is very dense there, hindering all observations."

Sections of strata traversed by wells made for and communicated by Mr. W. Fowler, at Yarrow, in the Hundred of Clinton, on the west side of head of St. Vincent's Gulf:—

No. 1. Section 315, Hundred of Clinton, in creek. Height of surface, 78 feet above high-water, determined by spirit level.

	Feet.	Remarks.
1. Red loam and gravel ...	78	Brackish water
2. Rock, an impure mixture of sand and lime ...	6	Contains roots of trees, evidently of mangroves
Total	84	

"This well is nearly one mile from the sea, but the water found on it is at exactly the same level as the sea at present. It also shows that the sea must have been at the same level as now when the mangrove roots, now fossil, were growing." W. Fowler.

No. 2. Section 313, half-a-mile north-west of No. 1. Surface 186 feet above high-water by spirit level.

	Feet.	Remarks.
1. Red clay	30	
2. Soft sandstone... ...	100	Water found at 130 feet
3. Very fine running sand	15	Sinking stopped by inflow of water, not fresh, but good enough for sheep
Total	145	

No. 3. Section 275, in creek, one and a-half miles north of No. 2. Surface 165 feet above high water. Very brackish water was reached at 165 feet from surface. The nature of strata exactly as in No. 2 well.

Well section, at about ten to eleven miles west from Lake Torrens, near Whittata, communicated by Mr. H. Lattorff:—

	Feet.
1. Bright red sandy soil	3
2. Soft red clay	15
3. Darker red sandy clay	27
4. Fine yellow reddish sand	13
5. Whitish sandy clay with ironstone boulders ...	12
6. Bright yellow, white, blue, and then red clay-slate	58
Total	128

Below 128 feet, at which saltwater was met with, there occurs a hard red slate containing mica.

Mr. Lattorff writes, July 24, 1880, that the rainfall during the four seasons he has been at Whittata has fallen between four and seven inches per annum; that the rain does penetrate the soil for more than four feet on the average, except in favoured places, where we have found damp ground to seven feet, or when saltwater lies near the surface. This is the result arrived at from observations made in the course of trial sinkings and excavating dams to the number of about forty.

A Scheme for the Organization and Direction

OF THE

EFFORTS OF AMATEUR COLLECTORS.

EDITED BY THE PRESIDENT AND HON. TREASURER.

Extracts from Regulations of the Society.

1. The Royal Society of South Australia, being desirous of encouraging the study of Natural Science, is prepared to direct the efforts of amateur collectors, and to receive from them observations and specimens—undertaking to record original observations, and when practicable to identify specimens. Those willing to engage in a systematic correspondence are requested to communicate with the *Hon. Secretary, Adelaide.*

2. Persons co-operating with the Society in recording Natural Science phenomena in this province be entitled "Local Correspondents."

3. A list of local correspondents be appended to the "List of Members of the Society," published in its Transactions.

4. Approved communications from local correspondents and members, and records of new facts, not being of the nature of a formal paper, be published in the Transactions of the Society under the title of "Miscellaneous Contributions to the Natural Science of South Australia," and that a reprint of the same be transmitted to each local correspondent.

NOTE.—Eminent Australian naturalists have consented to act as referees in their respective departments.

INSTRUCTIONS.

1. Not fewer than two specimens of each kind of plant should be forwarded; also of other objects, particularly shells, insects, crabs, polyzoa, and fish, when not too bulky. In the case of those plants and animals in which the sexes are in different individuals, one example at least of each sex should be sent.

2. Each specimen, or each set of specimens should be distinctively numbered; and the duplicate specimens retained by correspondent should be numbered correspondingly.

3. Notes on the habits, habitat, station, food, native and colonial names, and other particulars should be recorded at the time of observation. The memorandum referring to any specimen should be docketted with a number corresponding with that affixed to the specimen.

> The life history of nearly all Australian animals is meagre, and there is little fear that the information which you can afford is of "no use," because "too little," or is, apparently, "what every one knows." Plants from districts far inland, or recently settled, are very desirable. Do not exclude from your local collection any object merely because it occurs frequently or appears insignificant.

4. Parcels not exceeding one pound in weight, nor of greater dimensions than two feet by one foot, may be forwarded by post (suitably protected against breakage or crushing), if directed as follows:—

Natural History Specimens, without Letter.

From —(add name and address)

To the

Director of the Natural Science Section,

Royal Society, Adelaide.

The rate of postage is one penny for each *two ounces*.

5. If a parcel be too large for transmission by post, describe contents and suggest mode of transit to the Director, whose advice should be awaited, so that unnecessary expense may be avoided.

6. As it is very desirable that correspondents should get beyond mere collecting, the Society will endeavour to obtain information touching works suitable for study or reference, and in other respects will help them in completing and perfecting the scientific results of their observations.

7. Applications for a money grant should state the amount required and the mode and object of the proposed outlay.

SHORT DIRECTIONS

FOR

COLLECTING AND PRESERVING.

MAMMALS.—*Skins* may be dressed with arsenical soap or alum and salt (see Appendix). *Skeletons* (the skulls are most important) may be cleaned by the agency of ants. For this purpose the skeletons, coarsely divested of their flesh, are placed in a box and set over an ant's nest, holes in the box being made for the passage of the insects. *Skulls* may be prepared by cautious boiling and subsequent removal of the flesh. *Bodies of smaller kinds* may be preserved in spirit or other preserving fluid after removal of intestines.

BIRDS.—Skins and skeletons as in the case of mammals. Preserve skulls, breastbones, feet, and eggs.

REPTILES, as in the case of mammals; they may be killed by being violently thrown on soft ground, or by a knife stab at the junction of the head and neck.

FISH.—Smaller kinds may be preserved in spirit. Larger reptiles and fish may be cut through lengthways, and the half skin glued or sewn on pasteboard.

Note the contents of the stomach or crop of the foregoing to determine the food.

INSECTS may be sought for under the bark of living trees, under stones, about and in the carcases of decaying animals, on the leaves and flowers of herbs, shrubs, and trees, and in pools and streams. Some must be sought for at night by the aid of a lantern. Most may be captured by hand. Small forceps are useful to pick up insects, especially the noxious ones; but some others, as butterflies, may be caught by a muslin bag-net, and the aquatic species may be taken by the same means.

Delicate specimens may be temporarily pinned to a layer of cork or agave stem, in the crown of a tall hat. A captured insect, not being a butterfly or moth, should be killed by

placing it in a wide-mouthed bottle of a size convenient for the pocket, in the bottom of which has previously been placed some pieces of cyanide of potassium *(highly poisonous)*, covered by a layer of blotting-paper or fine sawdust. The bottle must be securely corked or stoppered. In the absence of cyanide of potassium, the insects may be killed by immersion in spirit, and beetles by dipping them into hot water. Small beetles, ants, &c., must be gummed on card circles. A great many insects, particularly beetles, may, after careful drying, be packed in layers with fine sawdust in a tin box; the lid of the box should be made secure against the ingress of those small insects which are so destructive to entomological specimens.

Butterflies and moths may be killed by a pinch between the fingers just beneath the insertion of the wings. The insect its wings having been carefully brought together, is to be placed in an envelope of paper (of the stiffness of stout writing paper) of the form here described:—Take a square piece of paper, fold it diagonally, but so as to make the upper triangular piece a little smaller than the lower; place the butterfly between the folds, and now turn over and press down the overlapping margins of the lower triangle. The size of the original square must be determined by the size of the insect, so as to make the envelope just large enough to prevent the insect shifting. When dry the envelopes may be packed in layers in a tin box.

Spiders and the like.—Preserve in spirit, glycerine, or preservative fluid. Note habits, kind of web, nests. The colours should be described in life; the special points for description are the number and position of the eyes, jaws, relative length of legs, shape of breast-plate, male palps, and epigyne of female.

Crabs, crayfish, shrimps, and the like; and Starfish, and sea-urchins should be immersed in spirit for a minute, or just long enough to destroy life, and afterwards dried rapidly by artificial heat, below that of the boiling point of water. In the case of the salt water forms it would be well to wash them in fresh water before treating them with spirit. Small specimens may be kept in the spirit or preservative fluid.

Marine Shells.—Endeavour to procure them with their animals. Some cling to rocks, others beneath loose stones, or burrow in sand or mud between tide marks. Extreme low tides should be availed of to secure those which habitually inhabit the region just beyond low tide mark; those still further out can only be procured by dredging, but are occasionally cast up on the beach during storms. Dead shells

accumulate towards high water mark. Particular circumscribed areas, at certain times, may be seen on close examination to be strewn with small shells, some microscopic; this *shell sand* is in great request, and should be gathered by lightly scraping it together by a lath or knife-blade; transfer to a bag. The coarser material may be removed by sifting. On sprinkling the shell sand on the palm of the hand, there should appear few grains of sand, the bulk should be small entire shells.

Snail shells, not having a natural polish, may be cleaned as follows:—Place in cold water, boil, drain off water, add cold water, and remove animal by a bent pin or cobbler's awl. Take care to return to the interior of the shell the horny or stony lid which closes the aperture of the shell when the animal is withdrawn within it; plug in the *operculum*, as this is called, with cotton wool. Shells having a natural polish should not be boiled, but may be buried in sand, and after the animal has rotted away, washed with cold water.

The animals of mussel and cockle shells may be killed by immersion in boiling water. Taken from the water, the valves gape widely; dry inside and outside, close the valves by the pressure of the thumb and fingers of one hand, and wind a moistened thread or tape two or three times around the shell and tie. Small examples of snails and other shells may be dried in sand. A few living specimens of each kind should be preserved in spirit. Homœopathic bottles are useful to keep small specimens distinct.

Land Snails abound most among craggy rocks of the hill country, and may be found among the crevices of rocks or under large stones, or collections of damp leaves.

Freshwater Snails and mussels occur in most waters, some living on the aquatic plants, others buried in the bottom mud. They may be collected by hand, but more conveniently by means of a perforated tin-pannikin fixed to the end of a stick. After scraping over the bottom with this dredge, wash by shaking in water, examine residue, and transfer shells to box or bottle.

The after treatment for the land snails, freshwater snails, and mussels is the same as for sea snails and cockles.

Polyzoa are thrown up on sea beaches, especially from deep water; some have the aspect of delicate seaweeds, others of corals. The horny flexible kinds are generally grey or light-brown, reddish if alive, curl inwards on drying. Individual cells require hand magnifier to bring out details. Many of this class of animals are parasitic on seaweeds (especially on root-like bases), and encrust shells and stones. Information as to the live animals much needed.

PARASITES may be found on the fur or feathers of live mammals and birds, or attached to reptiles and fish. Internal parasites (particularly desired) live in the liver, stomach, intestines, or other organs of animals.

PLANTS are best preserved by drying. The apparatus for drying flowering plants, ferns, and mosses consists of a few smoothly-planed boards, newspapers, and coarse, stout, unsized paper, or blotting-paper. Upon one of the boards place a few folds of newspaper, a sheet of drying paper, on which the plants are to be carefully laid out, then another sheet of drying paper, and again more folds of paper, and so on. The number of sheets of paper to be placed between each sheet of plants will depend on the one hand, on the thickness and humidity of the specimens; on the other hand, on the quantity and quality of the paper one has at command. On the top sheet place a board, and upon that stones, bricks, or other weights, from 20 lbs. upwards, according to the consistency of the specimens. It is useful, also, to have extra boards or pasteboards the size of the paper, to separate thick plants from thin ones, wet ones from those nearly dry, &c. Another day's collection may be arranged in the same way on the top board, and another board used and the weights replaced. After a few days the specimens should be shifted into fresh sheets, and pressure continued until all their moisture is dissipated Care must be taken that the paper used is well dried. In dry weather, and by the use of coarse, stout paper, the majority of plants require only one shifting. Succulent plants may be dipped in boiling water all but the flowers, preparatory to drying. Heaths and other plants which are apt to shed their leaves during drying may be treated in the same manner. Thick stems should be pared down.

Plants for preservation should be carefully selected, so as to show the various parts proper to them, not only in flower, but in fruit (both young and mature). Small plants should be gathered with their roots; the root-leaves of larger herbs should be secured, and others may be cut or folded into requisite lengths. Plants may be gathered into a tin box; but better suited for this climate is a portable collecting and drying apparatus, which consists of sheets of stiff paper, 14 inches by 9 inches, or more, separately folded between boards, or open wooden frames, with crossbars, connected by straps towards the ends, and having a third passing lengthwise around. The portfolio is a little bulkier and heavier to carry than the collecting-box, but its advantages are much greater, and its employment is imperative in the case of plants whose flowers close or wither soon after gathering; and though it is advisable to transfer the plants from it to the ordinary drying press on

reaching home, yet neglect to do so is not attended with such disastrous results as with the collecting-box.

A slip of writing-paper, on which the date, place, and situation in which the specimen was gathered should be attached, and note should be taken of the stature, habit, colour of the flowers, or of any other particulars which the specimen itself cannot supply, or which may be lost in the process of drying. A ready mode of attaching a label to a plant is making a loop in the middle part of the paper by two longitudinal cuts, through which the stalk or other part of the plant is passed.

The perfectly dried plants may be packed up in bundles, with a single sheet of paper between each layer. They may be placed very closely on the sheets, but not in more than one layer on each sheet, and care must be taken to protect the bundles by sufficient covering from the effects of external moisture or the attacks of insects.

The Society being desirous of collecting material for a report on the introduced plants, seeks information in reference to each plant as follows:—

Whether a weed of cultivated or pasture ground.
Whether an escape from cultivation.
Date of its appearance.
The extent of its spread.
Whether on the increase or decrease.
The conditions most favourable for its propagation.
Its utility or inutility.
Duration of flowering.
Its common name.

Seaweeds should be searched for among the rock-pools between tide-marks. Deep water algæ are occasionally cast up after storms, but they should be rejected if not fresh; they may be gathered into a linen bag. Empty collecting-bag into a basin of sea-water; select the best and cleanest plants and rewash. To Mount.—Float the seaweed in water and slip under it a piece of smooth drawing or fine white cartridge paper, arrange the specimen on the paper, and carefully remove from the water, press and dry between blotting paper. Thin plates of perforated zinc to support the mounting paper when in water, and to facilitate its removal therefrom, will prove useful. Most seaweeds will adhere to the mounting paper, but if it be wished to have them loose use calico instead of paper.

Geology.—Rock specimens should be broken off from rocks *in situ*, and not from rolled stones or boulders, though much useful information may be gained by proving them to belong to some distant locality. Take from interior parts unaffected by weather.

Fossil bones when friable may have something of their original condition restored to them by repeated soakings in a weak solution of glue.

Fossils in the form of casts or moulds are for the most part valueless.

The most useful form of hammer is one of solid steel, short and squared at the head, and the other side drawn to a point; the handle should have inches marked on it. A chisel is indispensable for cutting out fossils from rock surfaces. Old files make excellent chisels.

Specimens of rocks, minerals, and fossils should be separately wrapped in paper. Delicate fossils should be packed in saw-dust or bran.

Natural or artificial exposures of rocks should be measured in detail, the magnetic direction of the face of the section, and the amount of inclination of the beds to be noted. Take an example of each bed, numbering it correspondingly with the defining number in your description. Examine weathered surface for fossils, and state from what stratum of the section they have been obtained, and the frequency of their occurrence.

The following particulars relating to well sinking or borings are much desired by the Society. "Forms," to be filled up, will be supplied on application :—

SITE OF BORING OR WELL.
(To be described as accurately as possible.

HEIGHT OF SURFACE of ground above the sea at low water (stating whether found by spirit level, or barometer, or estimated.)

SIZE OF HOLE and how sunk.

Depth in feet below the Surface.		Nature of Strata.	*Remarks.
From	To		

* In remarks column refer to numbered specimens of strata and fossils found therein, which may accompany this statement. Also give depth at which water was found, stating whether fresh, salt, brackish, or mineral, and give any other information which may be of scientific or economic value.

Signature of Observer—

Date—

N.B.—The full equipment of a naturalist comprises a great variety of articles; but, under any circumstances, he considers the following indispensable:—Pencil, note-book, knife, string, pins, paper for wrapping, and match-box.

APPENDIX.

Recipes for Dressing Skins.

(1).—*Arsenical soap.*

Arsenious acid	4 ozs.
Soap	4 ozs.
Carbonate of potash	4 drams.
Camphor	1 oz.
Water	8 ozs.

Cost of ingredients about 2s. 6d.

Mix under a gentle heat. When used form a lather with any spirituous liquor and apply with a brush.

(2).—*A substitute for the above.*—Alum 3 parts, common salt 1 part, pure water 24 parts, by weight.

Recipes for Preservative Fluids.

(3). *Methylated spirit*, at 50 deg. over proof; price in Adelaide 7s. per gallon; may be diluted with an equal quantity of water.

(4).—*Wickersheimer's preservative fluid*—

Alum	10 drams	Dissolve in 300 drams of boiling water.
Common salt... ...	2½ drams	
Saltpetre	1·2 drams	
Carbonate of potash...	6 drams	
Arsenious acid ...	1 dram	

After cooling and filtering, add to every ten pints of this solution four pints of glycerine and one pint of methylated spirit. Cost of ingredients about 5s. per gallon.

Specimens that have been immersed for some days or weeks, according to their size, will keep out of the solution, and will remain plastic.

(5).—*Goadby's solution*, a substitute for spirit, may be employed for soft-bodied animals, without shells or bones—

Salt	4 ozs.	Add boiling water two quarts, well stir together, and filter.
Alum	2 ozs.	
Corrosive sublimate ...	4 grains	

(6).—*Glycerine.*—The disadvantageous property of corrugating and decolorising animal structures possessed by spirit is obviated by the use of glycerine. Retail price, 4s. 6d. per lb.

(7).—*An aqueous solution of alum*, in the proportion of alum 1 part, pure water 16 parts, preserves animal substances very well for a short time; all the parts retaining their natural conditions to some extent, except the bones and shells, which are acted on by its acidity. Retail price, 9d. per lb.

(8).—*Strong salt and water* may be used in the absence of any of the above, for quite temporary purposes.